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THESIS

**INTEGRATING SPACE SYSTEMS OPERATIONS AT
THE MARINE EXPEDITIONARY FORCE LEVEL**

by

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June 2015

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The Marine Corps is the nation's expeditionary force in readiness and is ready to act in any capacity, at any time, and any place. A critical enabler to the success of the Marine Corps against technologically advanced adversaries in remote, austere environments, is the ability to effectively exploit space-based capabilities to maximize the operational effectiveness of the force. To this end, the Marine Corps has invested in a number of tactical space-trained personnel but has not yet fully begun to integrate space operations into Marine Expeditionary Force training, exercises, and deployments.

This thesis reveals how dependent the Marine Corps is on space-based capabilities and reviews the current methods by which each Marine Expeditionary Force integrates space into day-to-day operations. This study finds that current progress is hindered due to a poor understanding among staff members of what space can bring to the fight, a non-standardized organizational structure within the Fires and Effects Coordination Center, the absence of uniform space training and assessment criteria, sparse equipment, and a critical lack of dedicated space-trained personnel to help plan for, train to, and exploit space-based capabilities. Recommendations are presented to mitigate these gaps and make better use of a critical capability.

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**INTEGRATING SPACE SYSTEMS OPERATIONS AT THE MARINE
EXPEDITIONARY FORCE LEVEL**

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

The Marine Corps is the nation's expeditionary force in readiness and is ready to act in any capacity, at any time, and any place. A critical enabler to the success of the Marine Corps against technologically advanced adversaries in remote, austere environments, is the ability to effectively exploit space-based capabilities to maximize the operational effectiveness of the force. To this end, the Marine Corps has invested in a number of tactical space-trained personnel but has not yet fully begun to integrate space operations into Marine Expeditionary Force training, exercises, and deployments.

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LIST OF ACRONYMS AND ABBREVIATIONS

0540	Space Operations Staff Officer
8866	Space Operations Officer
3Y	Space Enabler
A2/AD	Anti-Access Area-Denial
ACCM	Alternate Compensatory Control Measures
AOR	Area of Operation
ARSST	Army Space Support Team
BCT	Brigade Combat Team
BDA	Battle Damage Assessment
BLOS	Beyond Line of Site
C2	Command and Control
CMCC-CP	Combined Marine Corps Component Command Post
COA	Course of Action
COP	Common Operational Picture
COTS	Commercial off the Shelf
DC	Deputy Commandant
DCGS-A	Distributed Combat Ground System Army
DI&E	Data Integration and Exploitation
DOD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Material, Leadership and Education, Personnel and Facilities
DS4	Director of Space Forces
DSC	Defensive Space Control
D/T/ID	Detection, Tracking, and Identification
EA4SS	Executive Agent for Space Staff
EA	Executive Agent
EFDS	Expeditionary Force Development System
EMI	Electromagnetic Interference
ENVI	Environment for Visualizing Images
EW	Electronic Warfare

FA40	Space Operations Officer
FEC	Fires and Effects Coordinator
FECC	Fires and Effects Coordination Center
FFC	Force Fires Coordinator
FFCC	Force fires Coordination Center
FFT	Friendly Force Tracking
FMOS	Free Military Occupational Specialty
GIANT	Global Positioning System Interference and Navigation Tool
GPS	Global Positioning System
IMA	Individual Marine Augment
IMINT	Imagery Intelligence
IO	Information Operations
ISR	Intelligence, Surveillance, and Reconnaissance
JFC	Joint Force Commander
JFCC	Joint Functional Component Command
JSpOC	Joint Space Operations Center
MAGTF	Marine Air Ground Task Force
MARFORSTRAT	Marine Corps Forces Strategic Command
MAW	Marine Air Wing
MCCDC	Marine Corps Combat Development Command
MCIOC	Marine Corps Information Operations Center
MCISRE	Marine Corps Intelligence, Surveillance, and Reconnaissance Enterprise
MEF	Marine Expeditionary Force
METOC	Meteorological and Oceanographic
MEU	Marine Expeditionary Unit
MOS	Military Occupational Specialty
MSC	Major Subordinate Command
NAVWAR	Navigation Warfare
NLOS	Non Line of site
NRO	National Reconnaissance Office
NSSI	National Security Space Institute

OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OPIR	Overhead Persistent Infrared
OPLAN	Operation Plan
OPORD	Operation Order
OSC	Offensive Space Control
OTH	Over the Horizon
PP&O	Plans, policies, and operations
PNT	Position, Navigation, and Timing
ROK	Republic of Korea
SA	Situational Awareness
SATCOM	Satellite Communication
SCIF	Secret Compartmented Information Facility
SFE	Space Force Enhancement
SIGINT	Signals Intelligence
SSA	Space Situational Awareness
SSE	Space Support Element
STK	Systems Toolkit
STO	Special Technical Operations
TBM	Theater Ballistic Missile
T/O	Table of Organization
T/O&E	Table of Organization and Equipment
TOECR	Table of Organization and Equipment Change Request
TW&A	Threat Warning and Assessment
UFG	Ulchi Freedom Guardian
USASMDC	United States Army Space and Missile Defense Command
USSTRATCOM	United States Strategic Command

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I. INTRODUCTION

A. BACKGROUND

As the nation's expeditionary force in readiness, the Marine Corps prides itself on swift reaction and response to crisis or conflict in virtually any operating environment across the globe. Today more than ever, space-based capabilities have proven increasingly advantageous to achievement of national security objectives. As an advocate and master of maneuver warfare, the Marine Corps is poised to conduct combined arms operations throughout multiple warfighting domains anywhere in the world. Space-based capabilities have allowed the achievement of this end and have vastly improved the ability to accomplish synergy among the various warfighting functions. For more than a decade, the importance of harnessing space for Marine Corps operations has been made clear through the collaboration with Army Space Support Teams (ARSST) and Space Support Elements (SSE) in Operations Iraqi and Enduring Freedom. Their successes have highlighted the necessity of the Marine Corps to further expand the space cadre with the placement of key billet holders within the Marine Air Ground Task Force (MAGTF). Specifically, as a starting point, three space officer billets have been realigned to support the existing Marine Expeditionary Forces (MEF). Building on past successes and integration with ARSSTs and SSEs, the space officer combines subject-matter expertise with a diverse operational background to seamlessly integrate space into day to day operations. To ensure the operational success of the Marine Corps on geographically dispersed battlefields across the globe, it is incumbent upon commanders at all echelons to exploit the space officer and take full advantage of space-based capabilities.

B. PURPOSE

This thesis was born through a Marine Corps studies and analysis nomination form submitted by the current I MEF space operations officer. On a second space tour, it was recognized that current integration of space effects into Marine Corps operations have been ad hoc at best, stemming from the successful integration of ARSSTs and SSEs

in Iraq and Afghanistan as well as the recent successes of the space officer at III MEF.¹ Furthermore, recent trends have shown a lack of understanding of the role of the space officer as applicable to MEF-level operations, which has often led to a gross underutilization of the billet and ultimately a failure to capitalize on critical skillsets necessary to enhance combat operations. As a specific example, the I MEF space officer has been so oversaturated with collateral duties and billets that she has yet to perform a single space function in over two years of employment.

As a recent addition to the MEF staff, it is important that the space officer seamlessly integrate space-based capabilities into planning, training, education, exercise employment, and day-to-day activities to prepare for combat operations. However, given the fact that the Marine Corps is only an end user of space-enabled services and capabilities and does not acquire or operate space-based systems, the challenge of validating the existence and necessity of the space officer remains at the forefront of debate.

The overall purpose of this thesis is to analyze current employment trends among the three MEFs, capture best practices, and identify potential methods for integrating space support across future MEF level operations. Furthermore, a detailed analysis of current practices and historical space support to MEF operations should serve to educate readers and commanders at all levels of the importance of the billet and provide a template for incoming space officers to build upon and utilize.

C. RESEARCH QUESTIONS

The following research questions frame the problem at hand:

- What impact do space based capabilities have across the MEF range of operations and how do the various space force enhancement (SFE) areas influence the Marine Corps warfighting functions?
- What is the current method by which space capabilities are understood, planned for, integrated, and synchronized across MEF level operations?

¹ *Integrating Space Systems Operations at the Operational Level* (Studies and Analysis Nomination Form Ref: MCO 3902.1D) (Camp Pendleton, CA: United States Marine Corps, I Marine Expeditionary Force, 2014), 1-2.

- What current joint force space support models provide best practices for inclusion into Marine Corps space operating concepts and doctrine?
- What frameworks, processes, and table of organization and equipment (T/O&E) changes or implementations would most effectively integrate and synchronize space capabilities in future MEF level operations?

D. BENEFIT OF STUDY

This thesis should help identify a more efficient way to incorporate space operations at the MEF level. Thorough analysis of current levels of space support to the MEF will help identify shortcomings and lessons learned. Likewise, analysis of the current role of the space officer should improve employment opportunities within the MEF and lead to educational, billet assignment, and joint force support changes within the existing Marine Corps space cadre. Additionally, the potential identification of required T/O&E may help to streamline the way the Marine Corps integrates space systems operations at the MEF level. The end state is the eventual establishment of an effective space entity within the MEF that can quickly and effectively provide critical support to the expeditionary warfighter. As an added benefit, a solid space integration framework at the MEF will hopefully serve as the baseline for follow on integration at lower levels within the Marine Corps.

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II. ANALYSIS OF USMC SPACE SUPPORT REQUIREMENTS

A. SPACE POLICY

Following the strict guidance set forth in the 1999 Department of Defense Space Policy and more specifically by the 2001 Commission to Assess United States National Security Space Management and Organization, the Commandant of the Marine Corps signed the services first space policy in September 2009: “The Marine Corps must maintain and enhance its ability to exploit space capabilities, define space capability needs and interoperability requirements, develop a professional cadre of Marines educated in space operations, and actively participate in National Security Space activities.”² The Marine Corps space policy clearly recognizes that space based capabilities are a powerful, joint force multiplier. As a significant end user of space based capabilities, the Marine Corps highlights the necessity to actively participate in National Security Space endeavors in order to ensure continued benefit. The Marine Corps must have a voice in joint space initiatives, programs, and plans in order to advocate for specific Corps needs and capabilities. Accordingly, the space policy dictates that the Marine Corps will:

- Organize, train, equip, and provide Marine Corps forces to support MAGTF space operations as appropriate.
- In coordination with the other military Services, develop tactics, techniques, and equipment employed by Marine Corps forces for use in space operations as required.
- Participate with other Services in joint space operations, training, and exercises, as mutually agreed to by the Services concerned or as directed by competent authority.
- Develop a cadre of MAGTF personnel highly knowledgeable in space systems to support the Marine Corps in space planning, programming, acquisition, and operations. The Marine Corps will develop and maintain a sufficient cadre of space-qualified professionals to support the Department of Defense (DOD) Executive Agent (EA) for Space with space cadre personnel to represent the Marine Corps in DOD-wide planning activities.

² U.S. Marine Corps, Order 5400.53, Marine Corps Space Policy subsection 2.a (September 28, 2009).

- Fully assess Marine Corps warfighting doctrine, determine corresponding capability gaps, and conduct analysis to ascertain if space-based systems could meet those needs. Communicate the resulting needs to the EA for Space for integration into space plans and major space program capabilities documents, as well as associated acquisition programs.
- Plan for and integrate the essential enabling capabilities provided by space-based systems into the Marine Corps warfighting construct, to include networks, sensors, weapons, platforms, tactics, and doctrine.³

Pursuant to the above guidelines set forth by the Commandant, the Marine Corps has developed its space cadre and implemented strategies to ensure that its voice is heard with regard to joint force space planning and doctrine. Having just recently established a space cadre billet within the operating forces, it is incumbent upon all commanders to facilitate the growth of this position in order to exploit access to space-based capabilities as facilitated by the space officer. According to the Marine Corps Space Policy, commanders in the operating forces shall:

- Plan for and integrate space-based capabilities into operations and training plans.
- Identify capability gaps that could be solved by space-based systems via Marine Corps Expeditionary Force Development System (EFDS).
- Identify to Deputy Commandant (DC) Plans, Policies & Operations (PP&O) training requirements for assigned space operations personnel.
- Request space operations support as required.⁴

As evidenced above, the Marine Corps has drawn on the criticality of space concept from the National and DOD Space Policies and is only just now exploring the inclusion of organic space based personnel within the operating forces and the MEF.

B. DEPENDENCY ON SPACE

In the *2012 Capstone Concept for Joint Operations: Joint Force 2020* document, the joint chiefs highlighted the inevitability of a changing battlefield. “Space and

³ U.S. Marine Corps, Order 5400.53, Marine Corps Space Policy subsection 3.a.(1)(a-f) (September 28, 2009).

⁴ Ibid., 3.b.(10)(a-d)

cyberspace will play a particularly important role in the years ahead. As these domains figure more prominently in the projection of military power, operations in them will become both a precursor to and integral part of armed combat in the land, maritime, and air domains.”⁵ Over recent decades, the world has witnessed rapid advancements in the space domain. As the world’s leading player in space, the U.S. has long benefited from the uninhibited use of this domain and this point is illustrated by its growing use over recent decades. The former head of Air Force Space Command commented that “Our assured access to space and cyberspace is foundational to today’s military operations and to our ability to project power whenever and wherever needed across the planet.”⁶ The Marine Corps’ dependency on space is no different than any other service. In fact, one could argue that due to the expeditionary nature of the Marine Corps, and the inherently global nature of space based capabilities, that the Marine Corps has even more to gain through robust knowledge of and use of these capabilities.

Marine Corps warfighting doctrine embraces the maneuver warfare concept and recognizes Marine forces will conduct decentralized, combined arms operations across non-linear battlefields. These decentralized, distributed operations demand increased situational awareness, high operations tempo, increased mobility, and support in austere environments. The ability for dispersed forces to conduct simultaneous, over-the-horizon combat operations is an on-going need. This manner of warfighting and its inherent requirement for strategic agility and tactical flexibility has resulted in an increased reliance on space-based capabilities, to include satellite communications; space-based intelligence, surveillance, and reconnaissance (ISR); missile warning, space control and space-based position, navigation, and timing (PNT). These systems increase the combat effectiveness of the MAGTF and are key components in the employment of a synchronized combined arms force.⁷

⁵ Joint Chiefs of Staff, *Capstone Concept for Joint Operations: Joint Force 2020* (Washington, DC: Joint Chiefs of Staff, 2012), 2, http://www.defenseinnovationmarketplace.mil/resources/JV2020_Capstone.pdf.

⁶ Walter Pincus, “Hearings Show Our Dependence on Military Space Technology,” Washington Post, March 26, 2012, http://www.washingtonpost.com/world/national-security/hearings-show-our-dependence-on-military-space-technology/2012/03/24/gIQANVV8cS_story.html.

⁷ U.S. Marine Corps, Order 5400.53, 2.a.

The ability to project power whenever and wherever is embedded in Marine Corps maneuver doctrine and ethos. Maneuver doctrine emphasizes the need to seize the initiative in battle through the execution of decentralized combined arms operations accomplished with speed and surprise. According to the Marine Corps' capstone concept Expeditionary Force 21, expeditionary applies to a mobile force that can quickly respond to crisis or conflict with little resources for a sustainable amount of time until a more permanent force arrives.⁸ In other words, the Marine Corps must be capable of opposing the enemy or responding to disaster in austere environments where little to no infrastructure exists. As such, it is necessary that the Corps possess the requisite skills necessary to exploit all warfighting domains. In particular, the leveraging of space capabilities allows the ability to gain and maintain initiative across the spectrum of conflict. As mentioned before, the Marine Corps is merely a benefactor of the capabilities provided by space systems yet relies very heavily upon them. Consistent with current trends, the dependence on these capabilities has and will continue to increase.⁹

C. SPACE CADRE STRATEGY

Consequential to the 2001 report of the Commission to Assess United States National Security Space Management and Organization, the Marine Corps began initial development of a sustainable, trained space cadre. The commission concluded that all space professionals would have the task, among many, to master new complex technology and develop new doctrine and concepts of operations necessary to improve military use of space in order to achieve national security objectives.

Military space professionals will have to master highly complex technology; develop new doctrine and concepts of operations for space launch, offensive and defensive space operations, power projection in, from and through space and other military uses of space; and operate some of the most complex systems ever built and deployed. To ensure the needed talent and experience, the Department of Defense, the Intelligence Community and the nation as a whole must place a high priority on

⁸ U.S. Marine Corps, *Expeditionary Force 21* (Washington, DC: U.S. Marine Corps, 2014), 5, http://www.mccdc.marines.mil/Portals/172/Docs/MCCDC/EF21/EF21_USMC_Capstone_Concept.pdf.

⁹ U.S. Marine Corps, *United States Marine Corps Space Operating Concept* (Washington, DC: U.S. Marine Corps, 2013), 4.

intensifying investments in career development, education and training to develop and sustain a cadre of highly competent and motivated military and civilian space professionals.¹⁰

Appropriately, the Marine Corps manages a cadre of trained professionals in key billets throughout the operating forces, the supporting establishment, and joint and interagency communities. Their primary responsibility is to leverage space capabilities through continuous coordination with the national security space community for the overall benefit of the MAGTF. Thus, Marine Corps space professionals are categorized into two separate free military occupational specialties (FMOS), the Space Operations Officer (8866) and the Space Operations Staff Officer (0540). A key concept of employment of the 8866 and 0540 FMOSs is a thorough understanding of Marine Corps doctrine and operations through experiences gained while employed in one of the various primary military occupational specialties. Understanding the basics of amphibious operations and maneuver doctrine coupled with in-depth knowledge of the space domain make the 8866 and 0540 particularly qualified to advise the MAGTF commander concerning space based capabilities. Similarly, joint and interagency space billets require that these professionals accurately represent the best interest of the Marine Corps and advise the joint community on Marine Corps capabilities and specific needs that require space based support. As such, they will often be called upon to help develop future space architectures, strategy, and doctrine.¹¹

1. Space Operations Officer—FMOS 8866

Marine officers who are selected through the special education program can earn the FMOS 8866 after completion of a Master of Science degree in space systems operations or engineering from either the Naval Postgraduate School or the Air Force Institute of Technology. Upon completion of this challenging course of study, the 8866 is be expected to represent the Marine Corps in all applicable national security space

¹⁰ Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington, DC: Commission to Assess United States National Security Space Management and Organization, 2001), 18, <http://www.dod.mil/pubs/spaceintro.pdf.pdf>.

¹¹ U.S. Marine Corps, *Space Operating Concept*, 7.

endeavors. As per the Marine Corps military occupational specialties (MOS) manual, 8866s shall be equipped to have a comprehensive knowledge of space policy and doctrine, the space environment, and space relevant technologies to include orbital mechanics, space environment, communication systems, acquisitions, classified national systems, and joint doctrine for space operations.¹²

To fulfill the mission and best employ the 8866, the Marine Corps identified 13 joint and Headquarters Marine Corps billets:

- (1) U.S. Strategic Command (USSTRATCOM)
- (1) Joint Functional Component Command (JFCC)
- (1) Marine Corps Forces Strategic Command (MARFORSTRAT)
- (1) DOD Executive Agent for Space Staff (EA4SS)
- (1) Joint Space Operations Center (JSpOC)
- (2) PP&O
- (1) National Reconnaissance Office (NRO)
- (1) Marine Corps Combat Development Command (MCCDC)
- (1) Marine Corps Information Operations Center (MCIOC)
- (1) I MEF
- (1) II MEF
- (1) III MEF¹³

These 13 carefully chosen billets were selected so that the Marine Corps can maximize the benefits garnered from the national space community. As part of the focus of this thesis, the role, responsibilities, and current support to MAGTF operations provided by the MEF 8866 will be discussed in more detail beginning in Chapter III.

2. Space Operations Staff Officer—FMOS 0540

Similar to the 8866, the 0540 is uniquely qualified to advise the commander and his staff concerning national security space matters. Per the Marine Corps MOS manual, the FMOS 0540 qualifies Marine officers to help “develop requirements for space systems; make recommendations to decision makers in space systems acquisition management; conduct space application training; and/or participate in space operations

¹² U.S. Marine Corps, Order 1200.17E, Military Occupational Specialties Manual subsection 1146.18 (August 8, 2013).

¹³ U.S. Marine Corps, *Space Operating Concept*, 7-8.

planning.”¹⁴ The 0540 FMOS is attained by officers who attend an approved course of study at the National Security Space Institute (NSSI) of at least two weeks in duration. Currently, the Marine Corps has identified 49 billets that exploit the knowledge of a space trained 0540:

- (5) at MEF Headquarters
- (7) at Marine Expeditionary Unit (MEU) Headquarters
- (3) at Marine Division Headquarters
- (4) at Marine Air Wing (MAW) Headquarters
- (3) at Marine Forces Headquarters
- (5) at Headquarters Marine Corps
- (14) Serving in Joint Billets
- (4) Serving in Interagency Billets
- (4) Throughout the Marine Corps Supporting Establishment¹⁵

Target candidates for the FMOS 0540 are Marines that possess the primary MOS of either an intelligence or communications officer. These particular MOSs often apply operational functions that intersect the space domain and thus require relevant space-related training typically undergone in initial and follow on MOS schools. This FMOS complements their primary skillsets and uniquely qualifies them to make space-related recommendations to decision makers.

D. SPACE OPERATIONS DOCTRINE AND THE MAGTF

Fundamental to any space officer’s skillset is a thorough knowledge of space doctrine established through in-depth training and experience. We have already established that the Marine Corps is only a user of space based capabilities. However, in order to take advantage of the full range of benefits it is necessary for the MAGTF staff as well as the space officer to understand each of the doctrinal space mission areas. A thorough understanding of each area enables the space officer the ability to leverage available capabilities, contribute to joint planning and operations, and offer creative solutions to ill-defined operational challenges. Joint Publication 3-14 organizes space operations into five distinct categories:

¹⁴ U.S. Marine Corps, Order 1200.17E, 1108.6.

¹⁵ U.S. Marine Corps, *Space Operating Concept*, 8.

- Space Control
- Space Situational Awareness
- Space Support
- Space Force Application
- Space Force Enhancement¹⁶

The Marine Corps' contribution to these functional areas is minimal given that management is dominated primarily by other services but this is not to say that a solid understanding will not benefit the MAGTF and its mission. Generally speaking, the MAGTF space officer will be able to draw critical insights from each of these mission areas to enhance operational planning and mission execution. Figure 1 portrays an overview of each of the mission areas and respective functional areas.

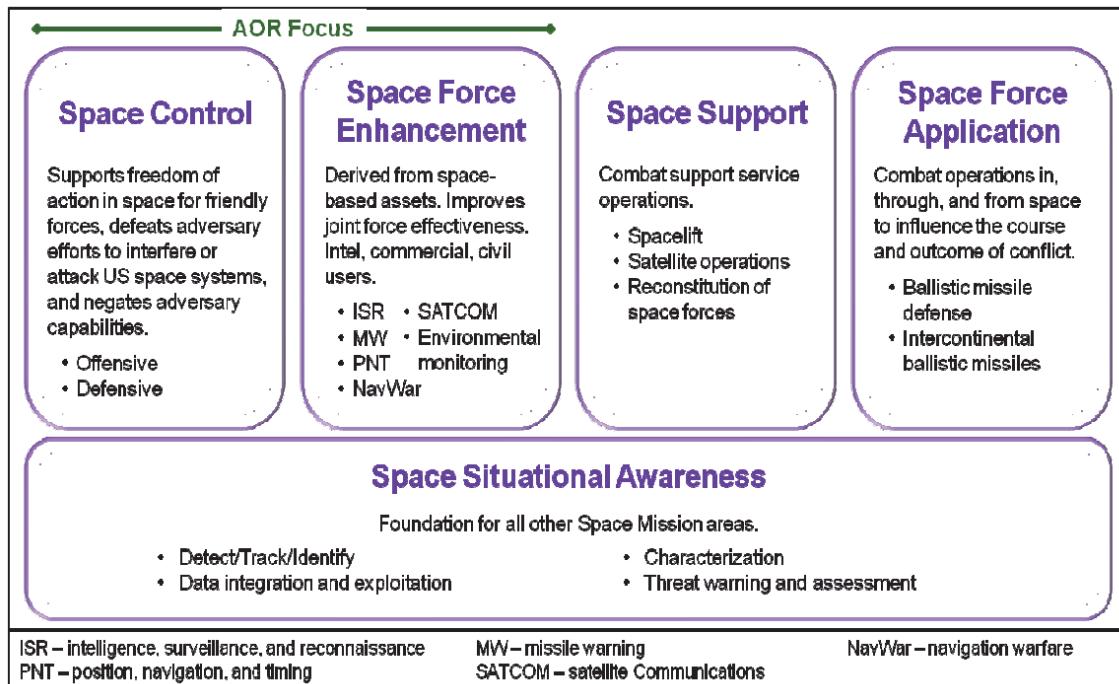


Figure 1. Space Mission Areas and Relationship¹⁷

¹⁶ Joint Chiefs of Staff, Joint Publication 3-14: Space Operations (Washington, DC: Joint Chiefs of Staff, 2013), x-xi, http://www.dtic.mil/doctrine/new_pubs/jp3_14.pdf.

¹⁷ Department of the Army, *Army Space Operations* (FM 3-14) (Washington, DC: Department of the Army, 2014), 3-2.

1. Space Control

Space control means are critical to maintaining an operational advantage in space. The success of the mission depends on the ability to freely exploit the space domain along with all applicable DOD and commercially owned space assets, services, and capabilities while simultaneously denying the enemy the same luxuries. Space control supports freedom of action in space for friendly forces, and when necessary, defeats adversary efforts that interfere with or attack U.S. or allied space systems and negates adversary space capabilities. It consists of offensive space control (OSC) and defensive space control (DSC). These operations change in nature and intensity as the type of military operations change.¹⁸

a. OSC

One of the many dilemmas brought about by the space domain is that it is free and open to use by any capable space faring nation. Whether capable or not, adversaries recognize the advantage afforded by space, therefore it is in their best interest to acquire US/third-party space capabilities and or employ their own or a combination of the two in attempt to deny our continued use. Offensive space control means seek to counter this thinking by both preventing and negating adversary efforts.¹⁹

(1) Prevention

Key to prevention is understanding that adversaries can and will explore various space systems that could pose a threat to national security objectives. The aim of prevention is to bar adversaries from employing such capabilities in a threatening manner. As pointed out in Joint Publication 3-14, various means of prevention could include diplomatic, informational, military and economic measures.²⁰ Much like any other force, the MAGTF is vulnerable to a host of space capabilities if employed correctly by an adversary. Therefore, the MAGTF space officer is equipped to identify these vulnerabilities and can articulate when and where they can occur. As a result, this

¹⁸ Joint Chiefs of Staff, Joint Publication 3-14, II-8.

¹⁹ Ibid.

²⁰ Ibid.

vulnerability analysis, provided it is included in the planning phase, may spark other agency action to prevent the adversary from acquiring said capabilities.²¹

(2) Negation

While preventing the adversary from acquiring access to critical space systems and capabilities is certainly the goal, it may not always be feasible. It may be the case that adversary access to harmful capabilities already exists therefore it is important that actions are taken to deceive, disrupt, degrade, deny, or destroy these capabilities. Certainly the Marine Corps does not possess the organic capabilities to negate adversary use of space based systems, however it may be able to support a coordinated attack on the ground segment through combined arms operations. The MAGTF space officer, in this case, can act as the conduit between the joint force and MAGTF planners in order to articulate which targets must be eliminated based on the threat posed to otherwise successful MAGTF operations.²² Likewise, the space officer, through an awareness of OSC capabilities and who controls them can act as the conduit through which these capabilities are requested and acquired.

b. DSC

The focus of defensive space control is not on thwarting enemy actions in space, but on preserving friendly abilities to exploit space based capabilities to ensure a continued operational advantage. The enemy is well aware of U.S. dependence on military and civil space systems and will make every effort to derail our capabilities in future conflict. Harmful effects to friendly systems can come in many forms. On the one hand, the enemy may employ a host of malicious capabilities such as satellite communication (SATCOM) jammers or lasers. On the other, naturally occurring events such as space debris, radiation, harsh weather effects and even unintentional radio frequency interference can all jeopardize effective employment of these systems. As

²¹ Joint Chiefs of Staff, Joint Publication 3-14, II-8.

²² U.S. Marine Corps, *Space Operating Concept*, 12.

such, it is necessary to employ various means to characterize, track, identify and resolve any anomalies in an expedient manner.²³

As an avid user of space-enabled capabilities, the MAGTF relies upon defensive space control services to ensure continued benefit. As a single example, the adversary may attempt to disrupt or jam friendly SATCOM services. In this case, the MAGTF space officer can assist in recognizing these harmful effects and understands the proper reconciliation processes that can restore services and mitigate harmful effects. Likewise, in the event the enemy attempts to degrade friendly ISR systems, the MAGTF space officer can assist in making relevant adjustments to the intelligence collection plan by recommending alternative collection platforms based on system specific capabilities and limitations.²⁴

2. Space Situational Awareness

Space Situational Awareness (SSA) is arguably one of the most important space mission areas as it essentially enables every other space based capability. SSA encompasses the techniques necessary to evaluate the space domain for potential threats and monitor the general well-being of friendly space based systems. SSA helps ensure the safe use of space for all nation states and implements a checks and balances system to ensure compliance with requisite space treaties and agreements. While SSA can be a cooperative effort, its mission is also leveraged to protect national military interests and enables the protection and use of friendly assets through various space control means.²⁵

Space situational awareness involves characterizing, as completely as necessary, the space capabilities operating within the terrestrial environment and the space domain. SSA is dependent on integrating space surveillance, collection, and processing; environmental monitoring, processing and analysis; status of U.S. and cooperative satellite systems; collection of U.S. and multinational space readiness; and analysis of the space domain. It also incorporates the use of intelligence sources to provide insight into adversary use of space capabilities and their threats to

²³ Joint Chiefs of Staff, Joint Publication 3-14, II-9.

²⁴ U.S. Marine Corps, *Space Operating Concept*, 13.

²⁵ Joint Chiefs of Staff, Joint Publication 3-14, II-1.

our space capabilities while in turn contributing to the Joint Force Commander's (JFC) ability to understand adversary intent.²⁶

Figure 2 illustrates how the four functional areas of SSA filter into the common operational picture (COP) and provide the commander with all the necessary information needed to make an informed decision.

²⁶ Joint Chiefs of Staff, Joint Publication 3-14, x.

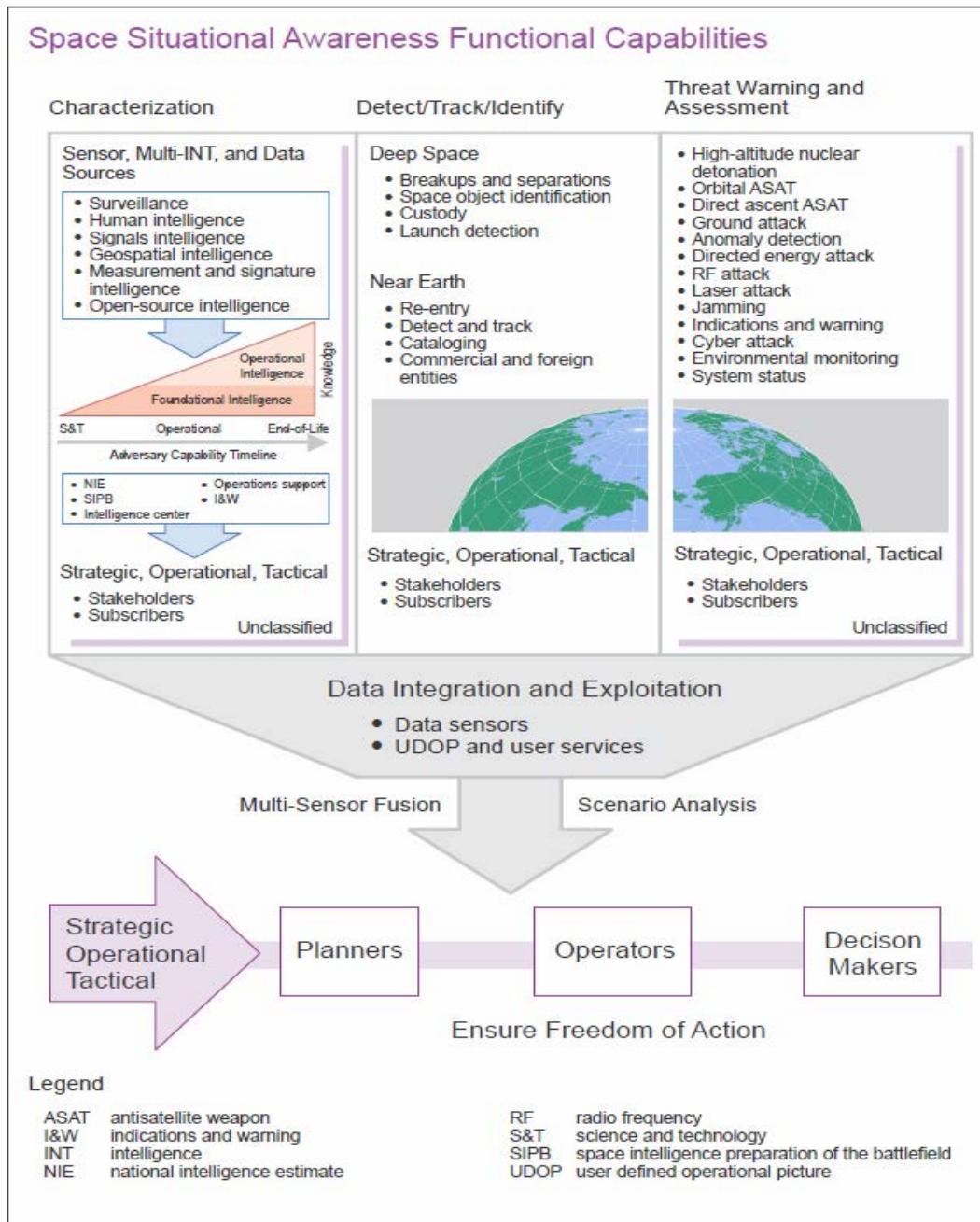


Figure 2. Space Situational Awareness Functional Capabilities²⁷

a. Detect/Track/Identify

A successful SSA mission is first enabled by the collaborated use of sensors to locate and observe objects and events in space for the purpose of categorizing,

²⁷ Joint Chiefs of Staff, Joint Publication 3-14, II-3.

monitoring and disseminating critical situational awareness information throughout the joint force. Detect, track, and identify (D/T/ID) data contributes to the overall COP and presents commanders with critical information needed to make informed decisions.²⁸

The MAGTF benefits directly from D/T/ID efforts. As an example, it can be a common misconception that particular overhead systems are always available. Sometimes this is not the case, as D/T/ID efforts can trigger satellite maneuvers that can have direct impacts on preplanned intelligence collection orders. With proper reach back capabilities and contacts, the MAGTF 8866 can obtain information on said maneuvers and inform commanders appropriately.²⁹ As a result, these efforts can sometimes lead to a critical shifts in plans for the better of the mission.

b. Threat Warning and Assessment

The Joint force will benefit from threat warning and assessment (TW&A) in that it provides warning of potential threats or events that may hinder space based capabilities. “TW&A is the ability to predict and differentiate between potential or actual attacks, space weather environment effects, and space system anomalies, as well as provide timely friendly force status.”³⁰

The MAGTF 8866 can contribute to the overall effectiveness of the operational plan by maintaining situational awareness with regard to TW&A in order to help mitigate possible negative effects that could occur from specific anticipated threats. As an example, if TW&A means have indicated a future space weather anomaly, the MAGTF space officer can make recommendations to the MAGTF commander with regard to changes in the satellite communications plan.³¹

²⁸ Joint Chiefs of Staff, Joint Publication 3-14, II-2.

²⁹ U.S. Marine Corps, *Space Operating Concept*, 13.

³⁰ Joint Chiefs of Staff, Joint Publication 3-14, II-2.

³¹ U.S. Marine Corps, *Space Operating Concept*, 13.

c. Characterization

Potential threats that are detected and assessed must be characterized in order to gain a better understanding of their intent, mission, and set of capabilities. Commanders benefit from this knowledge because it allows them to evaluate risk decisions based on the object in question and an assessment of its abilities that could potentially impact the mission.³²

The MAGTF 8866 may not be able to participate in the characterization of specific threats, however through detailed coordination and reach back, can remain informed of the situation and advise MAGTF commanders of the existence of potential threats that could negatively impact the mission.³³

d. Data Integration and Exploitation

The previous three functional areas of SSA have dealt with assimilation of various pieces of the space COP. Data integration and exploitation (DI&E) is the apex of the effort. The primary function is to merge associated data from multiple sources in order to provide the most detailed and exhaustive COP to the commander in support of decision making.³⁴ At a minimum, DI&E should provide the information technology capability to:

- Search and discover better sources of data and information across multiple organizations, missions, and security levels.
- Rapidly integrate that data into real-time SSA operations centers.
- Identify to the operator or commander the discovery and context of changes as they occur
- Retrieve, process, and store data according to its use (e.g., real-time or routine operations, training, rehearsal, research).
- Provide user-centric displays tailored to needs and access levels.
- Provide these functions via operator-centric displays and tools that permit autonomous or manual execution as well as reminders and status of pending or ongoing tasks (e.g., blue force status).³⁵

³² U.S. Marine Corps, *Space Operating Concept*, 13.

³³ Ibid.

³⁴ Ibid.

³⁵ Joint Chiefs of Staff, Joint Publication 3-14, II-4.

Ultimately, the space COP is the primary intelligence source from which the MAGTF 8866 draws in order to maintain situational awareness and provide accurate, timely, mission enhancing recommendations to the commander's operational plans and objectives.

3. Space Support

The space support mission area is composed of space lift, satellite operations, rendezvous and proximity operations, and reconstitution of space forces. Space lift consists of the ability to put satellites and other equipment into space. Satellite operations include the utilization of on-orbit space assets consistent with the mission and current needs. Rendezvous and proximity operations refer to operations that occur with one or more assets that are relatively close in distance to one another. Finally, reconstitution of space forces includes the maintenance and replenishment of on orbit capabilities as they become inoperable or obsolete.³⁶

Execution of the space support mission rests primarily with the Air Force, Army, and Navy. Although, as transparent as these operations may be to the MAGTF, they have a direct impact on the effectiveness of the mission. For example, if the Marine Corps is tasked to support an emergent crisis or disaster, active adjustments to a particular communications payload and satellite may be necessary in order to support optimal communication needs. Once again, having been integral in the Marine Corps planning process, the MAGTF 8866 will be well equipped to articulate specific on orbit asset needs through the proper channels.

4. Space Force Application

Space force application is defined as combat operations in, through, and from space to influence the course and outcome of a conflict. It consists of ballistic missile defense and other force projection capabilities such as intercontinental ballistic missiles.³⁷

³⁶ Department of the Army, FM 3-14, 3-15.

³⁷ Joint Chiefs of Staff, Joint Publication 3-14, II-9.

The MAGTF 8866 will be expected to have knowledge of the multi-tiered missile defense warning system procedures and processes. As a part of the operational plan, the MAGTF 8866 should be able to articulate the vulnerability of the MAGTF to enemy short range ballistic missile capabilities. This information will be critical during planning and throughout the duration of conflict.

5. SFE

As an expeditionary force in readiness, the Marine Corps will benefit most from the various SFE areas.

SFE operations increase joint force effectiveness by increasing the combat potential of that force, enhancing operational awareness, and providing critical joint force support. SFE is composed of ISR; missile warning, environmental monitoring; SATCOM; and PNT. They provide a critical advantage by reducing confusion inherent in combat situations. SFE operations also afford JFCs access to denied areas and persistence, which are not provided by comparable air, land, or maritime capabilities.³⁸

Undoubtedly, it is through these force enhancement areas that the MAGTF will capitalize on the gainful employment of a qualified, highly trained space subject matter expert. Through these experts the MAGTF will be able to plan, coordinate and integrate SFE functions into day to day operations.

a. *ISR*

ISR is an increasingly important force enhancement area that can provide a host of information in a variety of scenarios. Unlike ISR systems in the air, land, and sea domains, ISR systems in space are not restricted by national borders, providing a unique advantage during times of conflict. Whether during conflict or disaster relief, ISR assets are exploited to provide accurate and timely imaging and remote sensing of areas of interest. Space based ISR assets can provide the commander with critical information, to include the adversary's disposition, strength, location, and order of battle. This information has proven to be pivotal during the planning process and gives the commander and his staff a leg up when determining the best course of action to pursue.

³⁸ Ibid., xi.

ISR means have lasting effects throughout the conflict. Much like during the planning phase, ISR assets can be used for the duration in order to ensure the integration of intelligence and operations and to make timely adjustments to the plan resulting from a dynamic battlefield. From a diplomatic prospective, ISR systems can also be employed to monitor compliance with various treaties and agreements. Given the increasingly complex environments presented to the MAGTF, dependence on these systems has and will continue to grow.

Having received extensive training on a wide range of ISR systems and capabilities, to include U.S, allied and commercial systems, the MAGTF 8866 is uniquely positioned to provide critical ISR recommendations to the commander. Additionally, the MAGTF space officer will have the most extensive knowledge of new and emerging space based ISR systems and can leverage contacts throughout the joint space community to acquire necessary support. Together with the MAGTF intelligence staff, the 8866 will work with the Marine Corps Intelligence, Surveillance, and Reconnaissance Enterprise (MCISRE) to ensure integration among the various air, land, ground, and space assets.³⁹ Expeditionary Force 21 highlights that in future wartime and crisis response scenarios that it may not be possible to respond before completely eliminating all anti-access, area-denial systems (A2/AD). Furthermore, it is likely that the MAGTF will be unable to achieve air and maritime superiority prior to the mission. In this case, space based ISR systems will prove even more advantageous as they will not be exposed to typical A2/AD systems that most likely protect the littorals.⁴⁰ The effective collaboration between the 8866, MAGTF intelligence personnel, MCISRE and joint force will ensure that every commander has access to the most comprehensive repertoire of ISR capabilities and subject matter expertise.

b. Missile Tracking and Launch Detection

There is a constant, enduring threat of the use of ballistic missiles and chemical, biological, radiological, and nuclear weapons around the globe. As proliferation of these

³⁹ U.S. Marine Corps, *Space Operating Concept*, 15-16.

⁴⁰ U.S. Marine Corps, *Expeditionary Force 21*, 5.

weapons continues, the expeditionary nature of the Marine Corps makes it a vulnerable, likely target.⁴¹ Space based systems make it possible to detect, track, characterize, and disseminate necessary threat warning information throughout the joint force in order to defeat these attacks and safeguard exposed targets. The missile warning SFE area consists of missile tracking and launch detection.

Missile tracking includes launch, mid-course tracking, terminal phase re-entry, launch and impact prediction, nuclear detonations to support threat and non-threat determination, and follow-on decision making. Launch detection sensors provide real time and post-launch analysis to determine orbital characteristics and potential conjunctions with other objects in space.⁴²

These space based systems provide critical early warning data to the MAGTF. The MAGTF 8866 will ensure that the commander and staff are properly tied into the requisite, tiered theater warning systems and must maintain a method of rapid dissemination of missile warning data throughout the MAGTF and major subordinate commands (MSC).

c. Environmental Monitoring

The former Commandant of the Marine Corps commented in a forward to Expeditionary Force 21 that “the law requires and our heritage demands that we maintain a force that is naval in character and capable of conducting amphibious operations.”⁴³ This unique, amphibious nature is what sets the Marine Corps apart from other services. Critical to any amphibious landings and operations is a thorough understanding of the weather and specific area of operation. This often includes but is not limited to terrestrial weather, sea state, beach conditions, manmade or natural obstacles, vegetation, land use, and suitability for landing. Timely receipt of weather and space environmental data can provide the commander a clear picture of any impacts to plans and operations. During crisis response, the Marine Corps does not always have the luxury of conducting early

⁴¹ U.S. Marine Corps, *Space Operating Concept*, 16.

⁴² Department of the Army, FM 3-14, 3-8.

⁴³ U.S. Marine Corps, *Expeditionary Force 21*, 2.

planning and analysis. Therefore, space based weather assets can be leveraged as persistent overhead systems and for their ability to provide data that forms the basis for forecasts, alerts, and warnings for the space environment that may negatively impact space assets and operations.⁴⁴ Adverse space weather events and conditions can negatively impact space based systems and communications links which can have lasting effects on other critical mission enhancing services. It is the responsibility of the MAGTF 8866 to remain plugged into the source of this data through reach back in order to assist MAGTF Meteorological and Oceanographic personnel (METOC).

d. SATCOM

Military, commercial, and allied SATCOM systems are essential on the modern day battlefield. The advantages they offer are bountiful, allowing military forces to project power at great distances anywhere in the world. Chief among these advantages is the ability to communicate and exchange vast amounts of data in areas where no terrestrial communication infrastructure exists. Additionally, SATCOM extends reach back capabilities, to include the near real time transfer of mission critical data, intelligence, and the ability to tie into DOD information network systems.⁴⁵ Figure 3 provides a graphic depiction of some of the advantages that SATCOM affords the expeditionary warfighter.

⁴⁴ Department of the Army, FM 3-14, 3-7.

⁴⁵ U.S. Marine Corps, *Space Operating Concept*, 17.

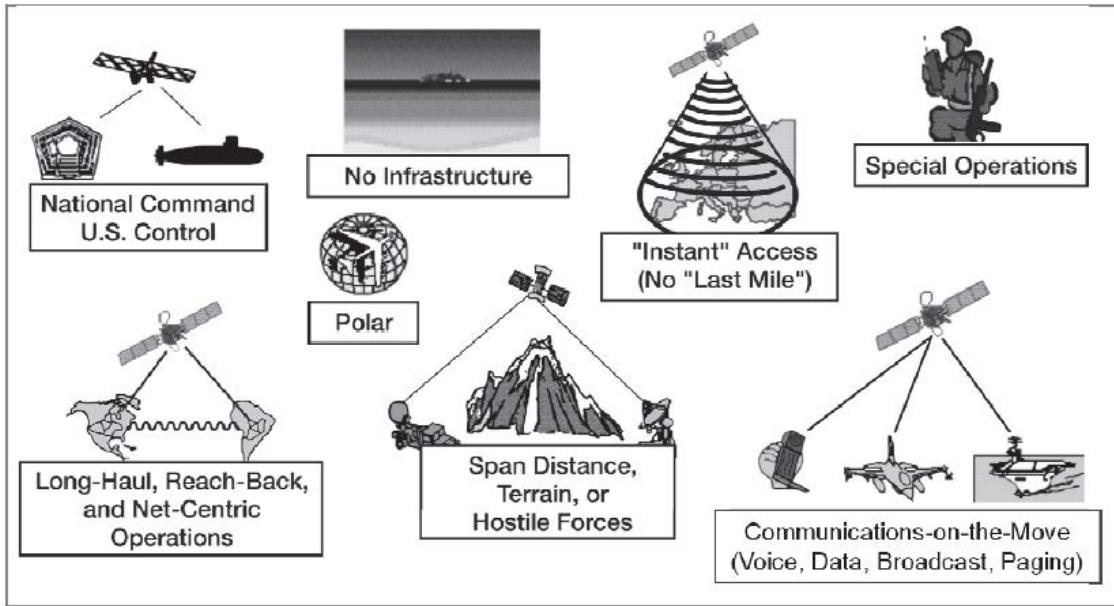


Figure 3. Key SATCOM Features⁴⁶

As an expeditionary force, the Marine Corps must be equipped to simultaneously support multiple conflicts or crisis operations in adverse conditions where large support bases are unacceptable or infeasible.⁴⁷ SATCOM enables this requirement and facilitates decentralized, beyond line of sight (BLOS) command and control (C2). Demonstrating our nation's growing dependence on SATCOM capabilities, Mark Scott, the Navy's current SATCOM Database Manager contends that many DOD SATCOM systems are becoming over-subscribed as various services continue to develop and field terminals, modems, and other required equipment that enable them to achieve higher data rates to accomplish their missions which require ever increasing tasking, collection, processing, exploitation, and dissemination capabilities.⁴⁸ The acquisition of technologically advanced warfighting means and equipment will continually increase the demand for SATCOM bandwidth.

⁴⁶ Department of the Army, FM 3-14, 3-10.

⁴⁷ U.S. Marine Corps, *Expeditionary Force 21*, 6.

⁴⁸ Mark Scott (N821 Navy Current SATCOM Database Manager), in discussion with the author, October 21, 2014.

The Marine Corps' dependence on SATCOM is undeniable. The MAGTF 8866 serves as an integral SATCOM resource to the commander and his staff. Based on knowledge of particular SATCOM payload capabilities, the 8866 can recommend the most efficient resource for a specific operation based on capacity and coverage restraints. During mission degrading outages, the 8866 can assist in troubleshooting and can leverage contacts among the satellite managing ground stations to help restore services as quickly as possible. Also, in the frequent case where one SFE area can benefit another, the 8866 might leverage environmental monitoring means to predict space weather affects and their impacts to SATCOM. As a result, critical changes can be made to existing plans to include the establishment of alternate means of communication.⁴⁹ The 8866s thorough knowledge of SATCOM will benefit the MAGTF staff and will ensure the commander maintains the ability to effectively command and control forces.

e. Space-Based Positioning, Navigation, and Timing

The global positioning system (GPS) constellation has been providing precise, reliable PNT data starting most notably during Desert Storm. It proved a unique advantage to U.S. forces operating in desert terrain, much of which was void of features that often aid in navigation. Today, GPS continues to increase the combat effectiveness of the military. Its capabilities allow operators to more effectively plan, train, coordinate, and execute operations.⁵⁰ Precise timing paves the way for synchronized operations and secure voice communications. It is a key enabler to the employment of accurate surface to surface and air to surface fires, allowing the ability to strike the enemy from great distances with pinpoint accuracy. As a navigation aid, forces at all levels can leverage data to better manage command and control and improve situational awareness throughout the battlefield. Given the many advantages that GPS provides, it is essential that the United States continue to enjoy uninterrupted use of these services.

Given that GPS services are free and available to use by any capable person with a basic GPS receiver, it is imperative that the United States safeguard its own GPS

⁴⁹ U.S. Marine Corps, *Space Operating Concept*, 17.

⁵⁰ Ibid.

capabilities while preventing enemy use or obstruction. As a sub-component of PNT, the mission of Navigation Warfare (NAVWAR) is to conduct “defensive and offensive action to assure friendly use and prevent adversary use of PNT information through coordinated space, cyberspace, and electronic warfare (EW) capabilities.”⁵¹

The MAGTF 8866 has had extensive training on the capabilities and functions of the GPS constellation. As a member of the MAGTF staff, the 8866 can serve as a valuable resource regarding PNT issues. With access to constellation status reports, he/she can advise the commander when anomalies occur that may affect the overall use of PNT services. The 8866 will also have access to specific GPS accuracy reports covering the area of operations. During GPS outages or periods of degraded services, these reports will highlight the danger of blindly relying on friendly force tracking (FFT) mechanisms and of employing GPS guided munitions until services are restored.

E. SFE AND MARINE CORPS WARFIGHTING FUNCTIONS

The Marine Corps warfighting functions consist of all the core functionalities that enable the commander to conduct combat operations and achieve mission success. According to MCDP 1-0, the six Marine Corps warfighting functions consist of:

- Command and Control
- Maneuver
- Fires
- Intelligence
- Logistics
- Force Protection⁵²

During mission planning and execution, the six warfighting functions are considered both individually and collectively. Each facilitates a particular mission set and often relies on the effective integration with each of the other existing functions to supplement its performance. Seamless warfighting function integration allows the commander the ability to maximize combat power to enhance effects during operations in

⁵¹ Joint Chiefs of Staff, Joint Publication 3-14, II-6.

⁵² U.S. Marine Corps, MCDP 1-0: Marine Corps Operations (Washington, DC: U.S. Marine Corps, 2011), Appendix B, <http://www.marines.mil/Portals/59/Publications/MCDP%201-0%20Marine%20Corps%20Operations.pdf>.

order to achieve a quick and decisive victory. Moreover, successful integration among each warfighting function ensures unity of effort and that there remains a single focus based on commander's intent.

As previously discussed, the various space mission areas multiply joint force effectiveness. Most important to the Marine Corps are the specific SFE areas. Each of the six warfighting functions are highly dependent on the space domain. Table 1 provides a brief snapshot of the benefits that the various SFE areas have on each of the primary Marine Corps warfighting functions. While not an all-inclusive list, it highlights the most important aspects of each SFE to warfighting function relationship. Following the table is a more detailed description of each warfighting function and the potential benefits gained by effective utilization of the space domain.

Table 1. Space to Marine Corps Warfighting Functions Crosswalk⁵³

Space to Marine Corps Warfighting Functions Crosswalk						
	Command and Control	Maneuver	Fires	Intelligence	Logistics	Force Protection
ISR	Mission planning; Geospatial info; Battlefield SA; Imagery; Terrain	Geospatial info; Battlefield SA; Imagery; Terrain	Target location/identification; BDA	IMINT; SIGINT; Battlefield SA	Imagery; Supply route identification and monitoring	Geospatial info; Battlefield SA; Imagery; terrain
Missile Tracking and Launch Detection	Mission planning; Launch notification; Impact point determination	Impact point determination	N/A	OPIR	N/A	Launch notification; Impact point determination
Environmental Monitoring	Misison planning	Weather impacts to mission; Mobility options; Accessibility; Maritime Operations	Weather impacts to mission	Weather impacts to mission	Weather impacts to mission; Mobility options; Accessibility	Weather impacts to mission
SATCOM	Mission planning; BLOS comm; Reachback	BLOS comm	BLOS comm; Call for fire	BLOS comm; Reachback; Product dissemination	BLOS comm	BLOS comm
PNT	Mission planning; FFT; Precise timing	FFT; Navigation	Precise targeting; OTH/NLOS targeting; FFT	Targeting; Personnel recovery	FFT; Supply transit visibility; Precise airdrop	FFT; Fratricide avoidance

ISR - Intelligence, Surveillance, and Reconnaissance; **IMINT** - Imagery Intelligence; **SIGINT** - Signals Intelligence; **SATCOM** - Satellite Communication; **PNT** - Position, Navigation, and Timing; **SA** - Situational Awareness; **BLOS** - Beyond Line of Site; **FFT** - Friendly Force Tracking; **BDA** - Battle Damage Assessment; **OTH** - Over the Horizon; **NLOS** - Non-Line of Site; **OPIR** - Overhead Persistent Infrared

⁵³ Department of the Army, FM 3-14, 3-20.

1. Command and Control

The Marine Corps defines command as “the exercise of authority and direction by a properly designated commander over assigned and attached forces to accomplish a mission.”⁵⁴ Command involves the personal endeavor by a commander to influence the conduct of his forces in all phases of war while control refers to the mechanisms by which a commander effectively issues orders and directives in order to maintain flexibility during the fog of war. The space domain and various SFE areas augment the command and control function by contributing to the commander’s overall situational awareness (SA). Communication is the single most important aspect of C2. The MAGTF commander relies on SATCOM to provide the ability to control forces without necessarily being at the point of friction through BLOS communications during all phases of conflict. As such, SATCOM is vital during initial stages when terrestrial communication means are not available. A key facet of Marine Corps warfare is the concept of decentralized C2, which affords subordinate commanders the opportunity to seize the initiative at the lowest levels without being physically tied to higher headquarters. SATCOM is the bridge that links the commander to his forces during operations spanning multiple geographic locations which facilitates speed, rapid maneuver, and the simultaneous response to crisis or conflict in multiple locations. Space based ISR systems provide the commander with critical intelligence about the enemy’s locations, strengths, and capabilities as well as information about the operating environment such as terrain analysis. Intelligence provided through these systems is used during all phases of conflict and helps facilitate the commander’s continuous decision making process. Finally, PNT capabilities are critical C2 enablers and FFT means allow the commander to keep tabs on subordinate units. Additionally, the universal timing signal provided by PNT is a critical piece when exercising mission command through information system architectures.⁵⁵

⁵⁴ U.S. Marine Corps, MCDP 1-0, Appendix B.

⁵⁵ Department of the Army, *Army Space White Paper: Gaining and Maintaining Access to Space Capabilities* (Washington, DC: Department of the Army, 2012), 12.

2. Maneuver

Maneuver is a fundamental warfare concept that involves the strategic movement of forces to gain an advantage over an opponent or seize an objective. The Marine Corps warfighting publication describes it as “a warfighting philosophy that seeks to shatter the enemy’s cohesion through a variety of rapid, focused, and unexpected actions which create a turbulent and rapidly deteriorating situation with which the enemy cannot cope.”⁵⁶ As an expeditionary force in readiness, the Marine Corps is fitted to project combat power at remarkable speed which requires a great deal of real time SA and rapid decision making. The various SFE areas simplify the command and control aspect of maneuver, facilitate SA, and speed up the continual decision making process. SATCOM improves the ability of the commander to effectively command and control subordinate units. BLOS communication allows the coordinated movement among geographically dispersed units in pursuit of a single objective. In austere, restrictive environments, all elements of the MAGTF depend on reliable, resilient communications while on-the-move.⁵⁷ SATCOM provides for this much needed aspect of flexibility. Likewise, PNT capabilities enhance navigation efforts and synchronizes the timing among mutually supporting and maneuvering units. GPS enhances a commander’s SA through various FFT means. The ability to instantaneously observe the locations of friendly units complements decision making and C2 efforts. Finally, in the case of adverse weather, environmental sensors may provide the commander with critical information needed to alter movement schedules and avoid otherwise inaccessible routes.

3. Fires

The fires warfighting function is critical to achieving the combined arms effort. “Fires use weapon systems to create a specific lethal or nonlethal effect on a target. Fires harass, suppress, neutralize, or destroy in order to accomplish the targeting objective, whether to disrupt, delay, limit, persuade, or influence.”⁵⁸ In order to successfully

⁵⁶ U.S. Marine Corps, *MCDP 1: Warfighting* (Washington, DC: U.S. Marine Corps, 1997), 73, <http://www.marines.mil/Portals/59/Publications/MCDP%201%20Warfighting.pdf>

⁵⁷ Department of the Army, *Gaining and Maintaining Access to Space Capabilities*, 15.

⁵⁸ U.S. Marine Corps, *MCDP 1-0*, Appendix B.

integrate fires into combined arms operations, the Marine Corps relies quite heavily on space based assets and support. ISR systems aid in the targeting process and can provide real time, accurate imagery of known target locations. Additionally, ISR systems provide a convenient battle damage assessment (BDA) option necessary to determine the need for follow on effects. During decentralized operations, SATCOM enables the call for fire functionality and ensures that fire and maneuver is fully integrated among adjacent and supporting units. SATCOM links the sensor to shooter and ensures seamless interoperability among ground and aerial strike assets. Finally, PNT enables the ability to drop ordinance with incredible accuracy, often reducing the negative effects of collateral damage as well as minimizing possible civilian and friendly casualties.

4. Intelligence

Intelligence is a critical warfighting function that constantly effects each phase of conflict. Intelligence is the driving force behind the commander's plan and helps shape the battlefield during execution. "It is a dynamic process used to assess the current situation and confirm or deny the adoption of specific course of actions (COA) by the enemy. It helps refine the commander's understanding of the battlespace and reduces uncertainty and risk."⁵⁹ As a function focused primarily on gaining information about the enemy, intelligence benefits from a wide range of collection means. In particular, space based ISR assets facilitate unimpeded observation of the enemy from the high ground and provide the commander with an accurate depiction of the enemy's strength, location, disposition, and movements. Access to this type of information is critical for the commander to rapidly examine the threat. Without SATCOM, the collection of overhead imagery would be useless. SATCOM facilitates the real time dissemination of intelligence products throughout the MAGTF and the joint force and assists rapid COA development and adjustments. Finally, environmental monitoring sensors are useful to detect adverse weather which will ultimately determine the type of assets necessary to overcome these conditions while still providing accurate and timely intelligence to the commander.

⁵⁹ U.S. Marine Corps, MCDP 1-0, Appendix B.

5. Logistics

The logistics warfighting function is what maintains and sustains the MAGTF as a fighting force. “Logistics encompasses all activities required to move and sustain military forces. At the tactical level, logistics is combat service support and involves arming, fueling, maintenance, transportation, supply, general engineering, and health services.”⁶⁰ Any effective expeditionary force must be equipped with a dynamic logistical support system. Space based assets enhance the delivery of this support and are critical during sustainment operations. The MAGTF can leverage ISR assets to survey the suitability of potential resupply routes. Environmental monitoring assets can help determine optimal weather conditions for delivery of supplies, either by land or air. SATCOM ties the logistician to the warfighter in order to facilitate seamless support over great distances. Finally, PNT capabilities help expedite the safe and efficient delivery of supplies by providing transit visibility and enabling the use of precise locations for injured personnel evacuation and tactical delivery of supplies by air.

6. Force Protection

Force protection is a critical warfighting function aimed at protecting friendly vulnerabilities in order to preserve the overall combat effectiveness of the force. “Force protection is the measures taken to preserve the force’s potential so that it can be applied at the appropriate time and place. It includes those measures the force takes to remain viable by protecting itself from the effects of adversary activities and natural occurrences.”⁶¹ Much like the other warfighting functions, various SFE areas augment the effectiveness of force protection conduct. As an example, ISR can provide imagery of a friendly operating base that may highlight vulnerabilities or defensive gaps. Missile tracking and launch detection provide yet another ability for a commander to maintain SA and protect vulnerable forces. Lastly, SATCOM and PNT further enhance SA and provide real time communications access and location awareness to a commander to facilitate force protection measures.

⁶⁰ Ibid.

⁶¹ U.S. Marine Corps, MCDP 1-0, Appendix B.

III. ANALYSIS OF SPACE OPERATIONS IN SUPPORT OF THE MEF

A. MARINE CORPS INVESTMENT IN TACTICAL SPACE

Over the past decade of conflict, particularly in Iraq and Afghanistan, the Marine Corps has benefited greatly from the collaboration with joint space support personnel. Specifically, ARSST integration with the MEF has been successful and has demonstrated the advantages gained through this unique employment paradigm. As a result, there was a critical change made to the FMOS 8866 billet assignments. Seeking to establish an organic space support capability within the MEF, the Marine Corps dismantled select billets tied to national and strategic levels in order to realign them with tactical warfighting commands. As such, three billets were removed from the Operationally Responsive Space Office and the National Security Space Organization and one was added to each of the three MEFs.⁶² This initiative marks the first step to creating an operational component of the Marine Corps space cadre. The billet realignment resulted in a zero sum game overall and allowed the addition of the 8866 billet on the MEF staff without creating additional force structure. Subsequently, the new billet assignments were approved by all three MEFs in 2012. The initial staffing goal required that the 8866 possess the rank of LtCol and has to have previously completed a tour acting in a space operations officer capacity. LtCol rank is desirable due to the level of coordination and interaction needed to fulfill billet requirements. Likewise, second tour 8866 Marines were targeted in order to bring an even greater depth of space knowledge to the MEF. The rest of this chapter outlines how the 8866 is expected to coordinate with the MAGTF staff and the current progress and employment of the 8866 within each MEF.

B. SUPPORT TO THE MEF COMMANDER, SUBORDINATE COMMANDERS, AND STAFF

Working together with the 0540, the 8866 is responsible to ensure that space based capabilities are fully exploited during planning and operations. As will be seen in

⁶² Joseph Horvath (HQMC PP&O, PLI), in discussion with the author, April 5, 2015.

chapter four, the team of MEF space professionals is tasked to fulfill much of the same duties as ARSSTs have during past integration. The Marine Corps Space Operating Concept states that the 8866 will support the MEF through three primary functions:

- Supporting the G-3, G-6, and G-2, while leveraging all space capabilities
- Acting as the conduit between MAGTF operators and the capability providers
- Advocating MAGTF space needs to service, joint, and interagency organizations⁶³

The MEF 8866 is expected to possess a broad understanding of the technical and operational aspects of all SATCOM, PNT, and ISR-related capabilities that have varying degrees of impact to Marine Corps operations. While organic MEF intelligence, communications, and operations personnel are equipped to exploit the space domain to some degree, the 8866 is tasked to fill the gaps, supplement their efforts, and facilitate seamless coordination among these disciplines. Therefore, the MEF 8866 is best employed strictly as an advisor to the commander, a coordinator among various MEF staff functions, and as the primary internal/external conduit of information regarding critical space capabilities as applicable to the mission. Figure 4 offers a simple organizational chart depicting the various lines of communication and integrating relationships both internal and external to the MEF. Solid lines represent a formal reporting relationship and dashed lines demonstrate the various informal coordinating relationships.

⁶³ U.S. Marine Corps, *Space Operating Concept*, 19.

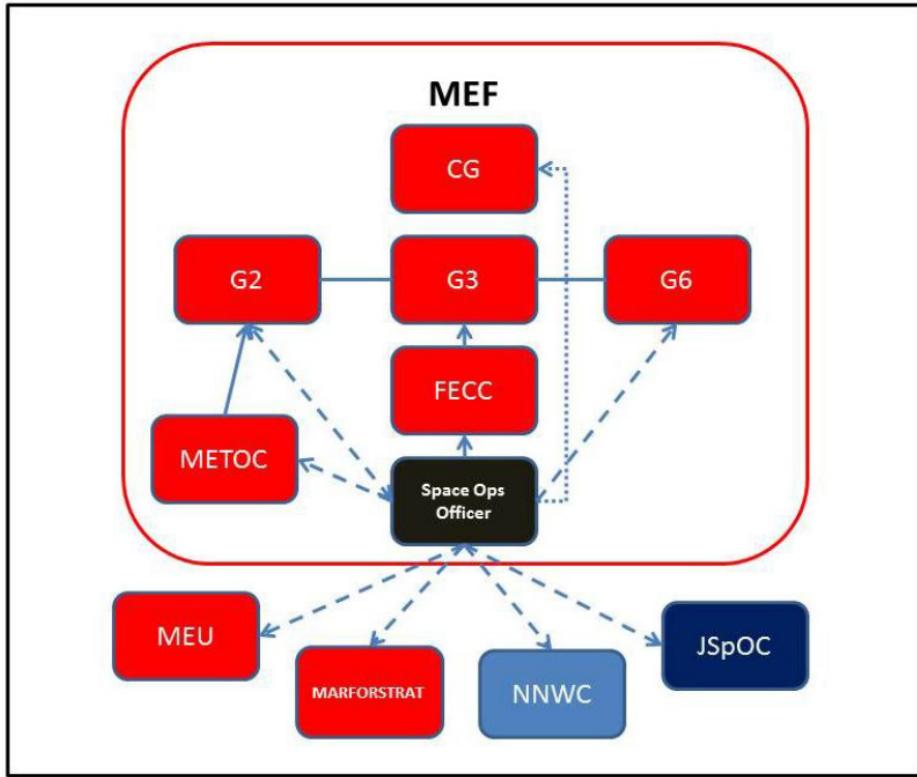


Figure 4. MAGTF 8866 Integration and Coordination⁶⁴

1. Support to the MEF G-3

Given the primary mission to coordinate space effects throughout the MEF staff, the 8866 has initially been employed within the G-3 Fires and Effects Coordination Center (FECC). Placement in the G-3, which is considered the driving force behind MEF operations, affords leverage to the space officer to recommend, coordinate, and advocate for SFE in support of staff efforts. Within the G-3, the 8866 will directly impact the planning process through development of the space operations portion to operational plans (Annex N) and aid other staff functions whose requirements intersect the space domain or electromagnetic spectrum. Aside from coordination with the primary staff sections, the 8866 will also collaborate in the G-3 with the other technical MOSSs including information and cyberspace operations and electronic warfare personnel. Placement of the 8866 in the G-3 not only supports the planning process, but supports

⁶⁴ U.S. Marine Corps, *Space Operating Concept*, 21.

ongoing operations as well. The dynamic nature of combat operations require that the 8866 maintain an accurate, updated space COP in order to supplement the inevitably changing mission plan.

FECC

The FECC is a mutation of the doctrinal Force Fires Coordination Center (FFCC) that has been expanded over the last decade and ultimately renamed to include an assortment of technical MOSs. Nevertheless, and much like the doctrinal FFCC, the FECC is the primary means by which the MEF plans, coordinates, and controls fires throughout the battlespace. It is through this mechanism that the MEF commander synchronizes all aspects of the plan in order to achieve effective fire support, conduct battlespace shaping operations, facilitate the joint targeting process, and ultimately select the best means needed to conduct combined arms operations. The following excerpt from the MAGTF fires publication summarizes the purpose of this critical warfighting organization:

The FFCC, under the cognizance of the G-3, is located in proximity to the combat operation center and provides the MAGTF commander the means to shape the battlespace with fires. Its mission is to ensure timely, efficient employment of organic and/or other supporting fires against enemy targets capable of affecting MEF battlespace and to plan and execute shaping operations through lethal and non-lethal fires, in accordance with the commander's guidance, to set conditions for success in the MAGTF.⁶⁵

From within the G-3/FECC, the 8866 will have authorization to coordinate external to the MEF, often times submitting space support requests pertaining to the MEFs area of responsibility. A thorough understanding of the commander's concept of fires will allow the 8866 to anticipate specific space support requirements and ensure that coordination is conducted early and often throughout the proper channels.

⁶⁵ U.S. Marine Corps, MCWP 3-43.3: MAGTF Fires (Washington, DC: U.S. Marine Corps, 2002), 2-8, [http://www.electronicsandbooks.com/eab1/manual/Hardware/M/military%20USA/Marine%20Corps/MCWP%203-43.3%2020021220%20MAGTF%20Fires%20\[132\].pdf](http://www.electronicsandbooks.com/eab1/manual/Hardware/M/military%20USA/Marine%20Corps/MCWP%203-43.3%2020021220%20MAGTF%20Fires%20[132].pdf).

2. Support to the MEF G-2

Throughout all stages of planning and operations, the MEF 8866 will serve as a valuable supplementary resource to the G-2. Of the many possible contributions, the 8866 will be able to advise the G-2 on a wide range of intelligence collection means that may otherwise go unused. G-2 knowledge of a particular capability does not necessarily mean it will be effective for all mission types. Given this fact, the 8866 is prepared to make specific asset recommendation based on the desired target or effect, technical capabilities of the system, orbit predictions, access requirements, and asset availability.⁶⁶ Similarly, the 8866 will work closely with G-2 METOC personnel to accurately predict space and terrestrial weather impacts to the collection plan. Intimate knowledge of the G-2 collection plan that is tailored to support the commander's scheme of maneuver will allow the 8866 the opportunity to garner outside intelligence support through joint space support agencies such as the JSpOC.

3. Support to the MEF G-6

As the primary communications support section to the MEF, the G-6 will rely heavily on the 8866 to help ensure the continued benefits gained from SATCOM. Not only will the 8866 understand the SATCOM systems and equipment organic to the MEF, but will also have knowledge of joint SATCOM support systems, architectures, and new and emerging technology. As more threats to the use of SATCOM arise, the 8866 will be able to assist the G-6 when troubleshooting degraded SATCOM systems and while exercising the electromagnetic interference (EMI) resolution process. Accordingly, and with a broad understanding of existing SATCOM architectures, the 8866 will assist the G-6 during reach back to external supporting agencies such as the Regional SATCOM Support Centers and the JSpOC EMI resolution center. The efforts of the 8866 will ensure that the MAGTF commander maintains unimpeded access to SATCOM capabilities for the duration of the mission.

⁶⁶ U.S. Marine Corps, *Space Operating Concept*, 23.

C. I MEF SPACE SUPPORT

Following approval of the MEF 8866 billet, I MEF gained its first space operations officer in the summer of 2013, a LtCol on a second space operations officer tour. As the first 8866 at I MEF, the necessity to establish a billet description, daily battle rhythm requirements, coordinating relationships, and other tasks and responsibilities would prove to be challenging. At the time there was no standing framework or process that dictated the steps necessary to inaugurate this billet. As a result and due to a number of critical staffing shortfalls, the I MEF 8866 was immediately tasked with duties inconsistent with the intended billet. In summary, the new 8866 was placed in the FECC only to fulfill duties outside of her primary responsibilities. Eventually, the I MEF 8866 ended up filling the billet of Staff Secretary and was completely removed from the G-3 and any space operations duties, which still holds true today.⁶⁷

Currently, I MEF retains the 8866 slot as part of the T/O&E and if utilized, would employ this billet in the FECC within the Current Fires Cell. The organizational chart depicted in Figure 5 shows the structure of the I MEF FECC and the placement of the 8866.

⁶⁷ Christine Rabaja (I MEF Staff Secretary), in discussion with the author, February 23, 2015.

I MEF G-3 FECC Organization

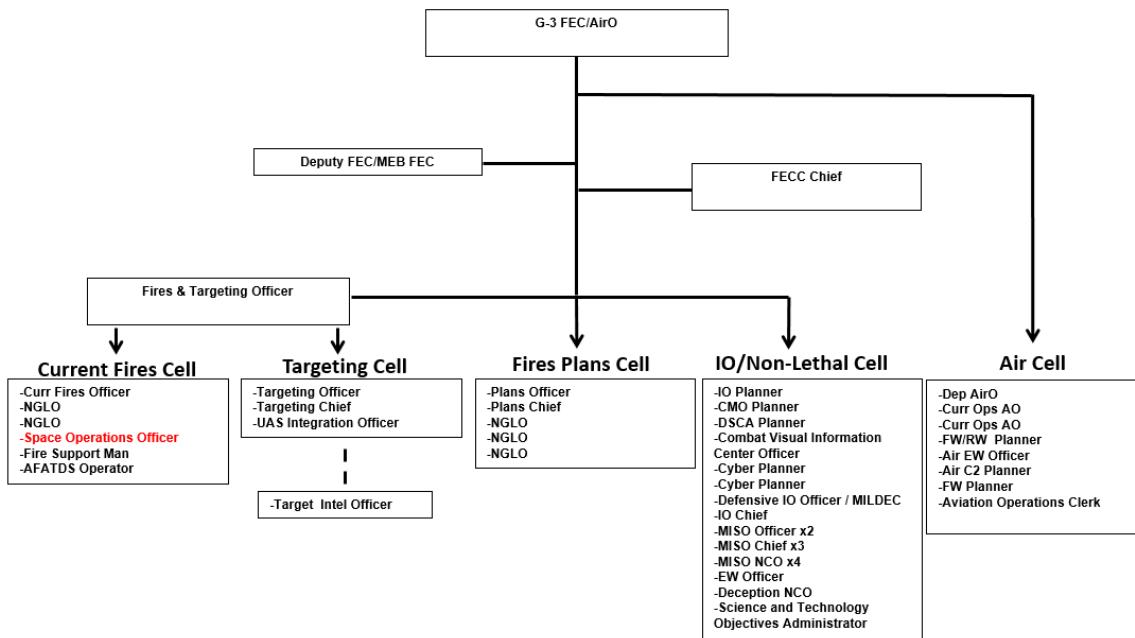


Figure 5. I MEF G-3 FECC Organization⁶⁸

It is important to note that this chart is a working document and does not depict the most up to date organization of the I MEF FECC. Despite the fact that the 8866 is not currently being employed in that capacity, I MEF has established that if employed the 8866 will reside in the current fires cell. Unfortunately, limited to no use of the 8866 by I MEF has neither validated nor confirmed this placement as a best practice.

The most current MAGTF fires warfighting publication states that the current fires section “executes the deep fight and coordinates fires for the close and rear fight, as required. This section monitors execution of the fire support plan, revises and adjusts the plan in keeping with the developing situation, and engages reactive targets per the MEF commander’s guidance.”⁶⁹ The impetus behind this placement is so that the 8866 remain abreast of the developing situation. It is understood that space activities effect the range of MEF operations and that future conflict has the potential to present dynamic

⁶⁸ Christine Rabaja (I MEF Staff Secretary), in discussion with the author, April 1, 2015.

⁶⁹ U.S. Marine Corps, MCWP 3-43.3, 2-10.

challenges within this unique warfighting domain. Therefore, I MEF has concluded that placement of the 8866 in the G-3 FECC is the best course of action going forward, yet has not yet taken the necessary steps to test the theory of this placement.

D. II MEF SPACE SUPPORT

One year after first and second MEFs received a trained 8866, II MEF was positioned to staff this billet with a newly graduated 8866 straight from the Naval Postgraduate School in the summer of 2014. The pegged candidate held the rank of Major and would be serving on a first space operations officer tour. Incidentally, II MEF was also undergoing a critical force structure review as part of a Marine Corps wide downsizing project. Unfortunately, the force structure review group cut the newly acquired 8866 billet from the table of organization (T/O) just as quickly as it was approved/added in 2012. The cutting of the billet turned out to be an unfavorable decision and to some extent can be blamed on the fact that since this was a new billet, there is a considerable amount of confusion as to the duties, responsibilities, and benefits to having an officer trained to exploit space based capabilities. After a fair amount of deliberation, II MEF was able to submit a revised table of organization and equipment change request (TOECR) advocating for the addition of an 8866 in the place of one of two technical information operations (IO) officers. Consequently, the TOECR was approved and the 8866 is now set to be staffed in the summer of 2015.⁷⁰ The inbound 8866 holds the rank of Captain and will be serving as a first tour space operations officer.

Analogous to I MEF, II MEF has prepared for the eventual inclusion of the 8866 within the G-3 FECC. Figure 6 represents a working II MEF organizational chart and highlights the desired placement of the 8866 once acquired in the summer of 2015.

⁷⁰ William Mangus (II MEF Deputy FEC), in discussion with the author, April 2, 2015.

II MEF G-3 FECC Organization

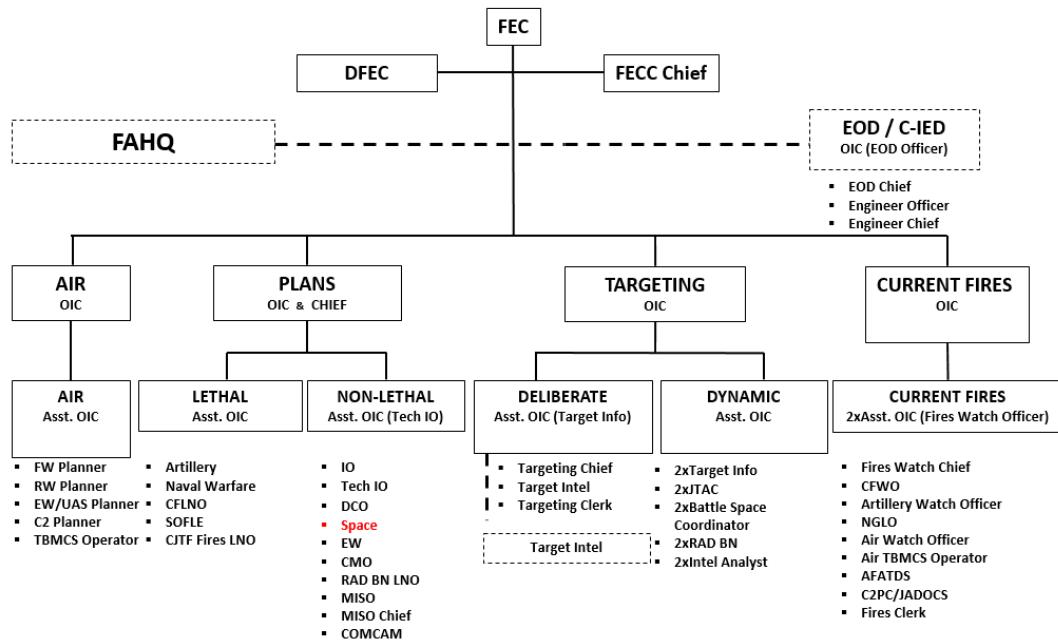


Figure 6. II MEF G-3 FECC Organization⁷¹

In absence of a trained 8866 and with little understanding of the billet's responsibilities, II MEF has initially elected to employ the space officer within the plans section of the FECC. According to the MAGTF fires publication, "the plans section is tasked with supporting the planning functions carried out in G-3 future operations and G-5 plans sections. The plans section is also responsible for the integration of various functional areas such as IO or engineer operations, into the fire planning and subsequent target development process."⁷² II MEFs concept of employment for the 8866 is based largely on the notion that space effects must be incorporated into MEF operations at the earliest opportunity. As a part of the planning team, the 8866 will have the ability to freely coordinate among various sections, ensuring that the commander is aware of any force multiplying capabilities afforded by the space domain. Currently, II MEF breaks down the plans section into two separate categories, lethal and non-lethal. II MEF advocates that Lethal refers to kinetic fires, whereas the non-lethal section deals more so

⁷¹ William Mangus (II MEF Deputy FEC), in discussion with the author, March 30, 2015.

⁷² U.S. Marine Corps, MCWP 3-43.3, 2-9.

with non-kinetic fires. Thus, the non-lethal section consists of the various technical MOSSs who are presumed capable of producing non-kinetic, non-lethal effects. II MEF has deemed it necessary to ensure that synergy is achieved among the various technical MOSSs which explains initial placement of the 8866 within this section.⁷³

E. III MEF SPACE SUPPORT

Similar to I MEF, III MEF staffed its first 8866 in the summer of 2013 with a Major fulfilling a second space operations tour. Instead of being immediately tasked with non-space related duties, the new 8866 was fortunately given leeway to begin building a detailed concept of employment. In accordance with the Marine Corps performance evaluation manual, the evaluation cycle must begin with the agreement of a clear understanding of the duties and responsibilities inherent to the assigned billet between the reporting senior and the Marine reported on.⁷⁴ Accordingly, and with the help of the Marine Corps space cadre, the III MEF 8866 developed the following proposed space operations officer billet description:

- Coordinate across staff and MSCs to integrate space capabilities into operations, exercises, and contingency plans.
- Develop courses of action and recommendations for operating environments where space capabilities have been denied. Write/review Annex N to OPLANS/OPORDs.
- Provide Navigation Warfare planning, implementation and remediation.
- Lead the cadre of AMOS 0540s, who are embedded in the MEF and MSC staffs, and supervise their annual training requirements.
- Coordinate and support staff and MSCs in developing requirements for space-based sensors and supporting space capabilities.
- Integrate Special Technical Operations (STO) into the Marine Corps Planning Process in support of operations, exercises and contingency plans.
- Coordinate and manage space-related requests for forces, and prepare for their integration into the MEF, including the integration of ARSSTs.

⁷³ William Mangus (II MEF Deputy FEC), in discussion with the author, April 1, 2015.

⁷⁴ U.S. Marine Corps, Order P1610.7F, Performance Evaluation System subsection 1006.1 (November 19, 2010).

- Develop space-related universal needs statements for MEF submission.⁷⁵

The particular duties listed above reflect a billet that requires extensive coordination within the MEF, MSCs, and joint and supporting agencies. III MEF deviated from the placement concept of the 8866 employed by I and II MEF. Rather than compartmentalize the 8866 under a specific section within the FFCC, III MEF decided to explore the idea of a standalone section that is directly responsible to the force fires coordinator (FFC). Figure 7 illustrates the basic, working FFCC organizational chart as operated by III MEF.

III MEF G-3 FFCC Organization

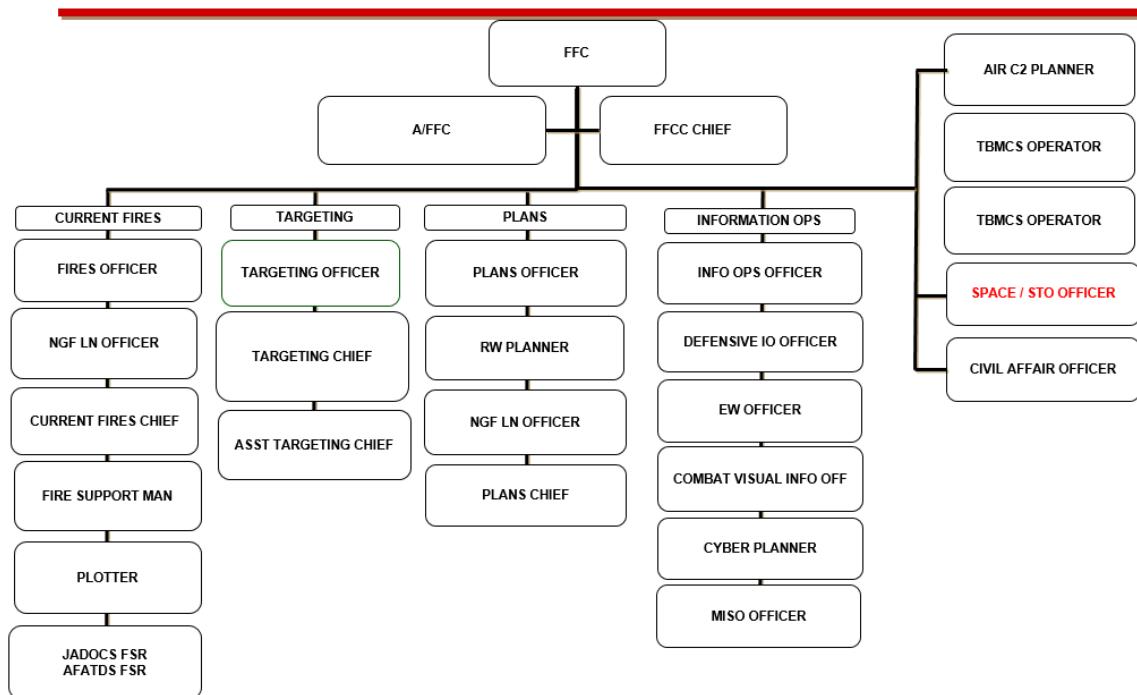


Figure 7. III MEF G-3 FFCC Organization⁷⁶

⁷⁵ Brian Anderson (III MEF Space Operations Officer), in discussion with the author, February 8, 2015.

⁷⁶ Chad Chorzelewski (III MEF Assistant Force Fires Coordinator), in discussion with the author, April 1, 2015.

Currently, III MEF still recognizes the doctrinal term FFCC as delineated in the MAGTF fires publication. However, as the development of technical MOSs and the FFCC expands, III MEF observes that fires and effects should be categorized under a single umbrella. As a part of fires and effects, the III MEF 8866 is best positioned to coordinate with the various technical MOSs, and has the freedom to engage key planners within each section of the MEF staff. Also, as a matter of housekeeping, the MEF 8866 billet is designed to be filled by a LtCol for previously stated reasons. Therefore, it does not make sense to be placed in a specific cell within the FFCC under a subordinate officer in charge. Consistent with the initial intentions and guidelines above, the III MEF 8866 immediately began building relationships and solidifying the role of the MEF space operations officer.⁷⁷

1. Establishing Relationships/Coordination

The real value of the 8866 is defined by the ability to augment the various warfighting functions through incorporation of SFEs which is accomplished through continuous coordination. From 2013 to 2015, the III MEF 8866 spent a considerable amount of time building relationships both internal and external to the MEF. The space community is inherently joint, therefore these relationships are extremely important in order to ensure the MEF remains involved and specific space capabilities are synergized with MEF operational plans and functions. Over the course of two years, the III MEF 8866 spent time collaborating with the MEF staff, to include the G-3, G-2, G-6, and subordinate communications and intelligence battalions. Concurrently, liaison was also made externally with the Pacific Command Director of Space Forces (DS4), United States Forces Korea DS4 at the 607 Air Operations Center, United States Army Pacific Command, United States Army Space and Missile Defense Command, Eighth Army Space Support Element, JFCC-Space and the JSpOC. The relationships established thus far continue to effectively shape the role of the 8866 within III MEF. Particularly, the III

⁷⁷ Brian Anderson (III MEF Space Operations Officer), in discussion with the author, March 19, 2015.

MEF 8866 noted that these supporting relationships/contacts were the genesis behind the gradual inclusion of space effects into MEF level exercises and training.⁷⁸

2. Training and Exercises

Since gaining an 8866 in the summer of 2013, III MEF has participated in a number of large scale joint exercises and has witnessed a slow and steady progression of space based injects into the training scenarios. The introduction of space training objectives into these various exercises was no easy task and continues to prove challenging. To date, the III MEF 8866 has participated in four such exercises and details concerning each are explained in the following sections.

a. Exercise Ulchi Freedom Guardian 2013

Exercise Ulchi Freedom Guardian (UFG) 2013 was the first time that the III MEF 8866 participated in a reoccurring joint exercise. Having arrived at III MEF only weeks before the beginning of the exercise, there was no time to properly plan or incorporate space planning events or problems into the scenario. Instead, the 8866 spent time working on MEF staff coordination and developing space contacts within the joint community. Additionally, valuable time was spent becoming familiar with the exercise by attending multiple working group meetings to include the combined space, information operations, targeting effects, combined targeting coordination board, and the non-lethal effects working groups. The 8866 also continuously monitored daily updates to the space situation in order to help lay the foundation for involvement of space operations during future exercises.⁷⁹

b. Combined Marine Corps Component Command Post Exercise 2014

Combined Marine Corps Component Command Post Exercise 2014 (CMCC-CP) was the next major opportunity for the III MEF 8866 to continue to build a concept of support and come up with valuable space training injects. CMCC-CP is a joint exercise

⁷⁸ Brian Anderson (III MEF Space Operations Officer), in discussion with the author, March 19, 2015.

⁷⁹ Brian Anderson, The First 100 Days as the III MEF Space Operations Officer (After Action Report) (Okinawa, Japan: III Marine Expeditionary Force, 2013), 4-5.

conducted by III MEF along with counterparts from the Republic of Korea (ROK). Having already built necessary relationships during UFG 2013, the MEF 8866 was able to concentrate more so on exploiting space based capabilities during the execution phase of the exercise. First time space training injects included SATCOM and GPS jamming scenarios initiated by the 8866 and the exercise white cell. During each event, the 8866 assisted the G-6 and G-2 in preparing joint spectrum interference reports. Furthermore, the 8866 helped facilitate the EMI resolution process and served as the conduit of space related products and information between the MEF and notional DS4. The MEF 8866 was also able to assist during an unplanned, real world satellite outage that affected the exercise communication plan. The timely, yet unplanned event helped validate the necessity that the space officer must remained plugged into current operations through the MEF FECC. As an after action item, it was noted that CMCC-CP 2014 provided the basis by which to generate a detailed Annex N, a task that has yet to be accomplished across the range of OPLANs throughout the Marine Corps forces.⁸⁰

c. Exercise Ulchi Freedom Guardian 2014

UFG 2014 provided yet another avenue to build the concept of space support to the MEF. As a major difference between the previous two exercises, Marine Forces Strategic Command provided a supporting 8866 who was co-located with the 607 Air and Space Operations Center. Having a co-located liaison within the joint space community was critical to ensuring that MEF operational needs and capabilities were accurately aligned with relevant space support. Through detailed coordination, III MEF was able to garner additional support directly from an ARSST that was deployed in direct support of the G-3 FECC. As a result, it was noted that successful integration indicated the need for a more permanent space supporting cast within the MEF structure.⁸¹

⁸⁰ Miguel Alvarez, *Summary for CMCC-CP Exercise (After Action Report)* (Omaha, NE: Marine Forces Strategic Command, 2013), 1.

⁸¹ Miguel Alvarez, *Exercise Ulchi Freedom Guardian (After Action Report)* (Omaha, NE: Marine Forces Strategic Command, 2014), p. 1-2.

d. Exercise Key Resolve 2014

Exercise Key Resolve marked the first time that the MEF 8866 was able to influence decision making within the FECC. To achieve this end, the following key space training objectives were submitted to the DS4 prior to commencement of the exercise:

- Request predictive tools products in support of operations
- Coordinate space control effects⁸²

In support of the first listed objective, the DS4 provided tailored space weather products to the MEF. Through reach back, the MEF 8866 was able to obtain these products and determine that space weather anomalies could lead to a potential degradation to critical SATCOM links. Armed with this critical information, the MEF 8866 helped develop an alternate communications plan with the G-6 that minimized potential outages and satisfied commander's intent. Successful implementation of this training objective has opened the door for future injects that will continue to validate the space operations concept of employment within the MEF.⁸³

3. Special Technical Operations

A common theme concerning space operations officer duties is the assumption of an additional collateral billet known as the STO planner. Space operations officers provide a natural fit to plan for and manage STO due to a combination of technical systems expertise and security clearance level. Due to the classification levels of certain space capabilities, the space operations officer is required to hold a top secret clearance with access to sensitive compartmented information. While STO planning is not necessarily always aligned with space operations, the space operations officer will typically be the most qualified to fulfill these special duties. Currently, III MEF has adopted this concept and has included STO planning as part of the 8866s billet description.⁸⁴ As an after action item from the previous mentioned exercises, the III

⁸² Brian Anderson, *The First 100 Days as the III MEF Space Operations Officer*, 7.

⁸³ Miguel Alvarez (Marine Forces Strategic Command, Space Operations Officer), in discussion with the author, April 30, 2015.

⁸⁴ Jonathan Matey (Naval Postgraduate School, Space Systems Academic Group), in discussion with the author, March 18, 2015.

MEF 8866 noted that the management of STO in the MEF is challenging given the sensitivity of the program and lack of necessary equipment, secure terminals, and an expeditionary sensitive compartmented information facility (SCIF).

IV. ANALYSIS OF ARMY SPACE SUPPORT MODELS

A. SPACE SUPPORT ELEMENT

The duties and responsibilities of the MEF 8866 most closely resemble those of the well-established Army SSE. In the early 2000s, the SSE was the Army's answer to providing an organic space support capability to the Army Corps and subordinate commands to include brigade combat teams (BCT) and a number of active and National Guard divisions.⁸⁵ Similar to the 8866, the Army SSE has the task to integrate SFE across Army warfighting functions, educate staff members on space capabilities and limitations, and act as the conduit between the staff and external space support agencies. The Army Space Operations field manual highlights eight specific functions and capabilities that each SSE is expected to provide:

- Provide space-based expertise, services, and training where applicable
- Provide space input and develop the space portion of the military decision making process
- Develop the space estimate
- Recommend space-specific priority intelligence requirements to the G-2
- Ensure G-6 awareness of SATCOM capabilities
- Provide support to information related capabilities
- Integrate United States Strategic Command unique capabilities for missile warning, PNT, environmental monitoring, and SATCOM capabilities into staff planning
- Be prepared to perform special technical operations duties and responsibilities, as directed⁸⁶

The organic SSE is an integral member of the staff and most of the benefit is derived from being directly involved with the planning process. As a member of the planning team, the SSE can estimate which SFE areas will best support the mission and request relevant support as needed.

⁸⁵ Eric N. Strom, "Space Support for the Warfighter: Determining the Best Way to Provide Space Capabilities at the Army Division and Brigade Levels" (master's thesis, Naval Postgraduate School, 2009).

⁸⁶ Department of the Army, FM 3-14, 7-1.

SSE Manning

The Army equivalent to the MEF is a three star commanded Army Corps. In contrast to one assigned 8866 on the MEF staff, the Army Corps is equipped with an organic SSE consisting of at least five space trained personnel. Similarly, the army staffs its divisions and BCTs with SSEs consisting of at least four and one space trained persons respectively. Table 2 displays the basic, yet tailorable breakdown of SSE support to each of the previously mentioned commands.

Table 2. Army Corps, Division, and Theater-Level Space Support Element Personnel Breakdown⁸⁷

Corps SSE	
Title	Rank
Space Support Element Chief	O5
Space Operations Officer	O4
Space Operations Officer	O3
SATCOM Systems Operator	E6
**Note: One of the Space Operations Officers doubles as the STO Chief	
Division SSE	
Space Support Element Chief	O4
Space Operations Officer	O3
STO Chief	O3
Theater Level SSE	
Space Support Element Chief	O5
Space Operations Officer	O4
Space Operations Officer	O4
STO Chief	O4
SATCOM Systems Operator	E6

As can be seen, the SSE in support of the Army Corps is top heavy in rank and possesses a team that can adequately fulfill the mission and support a large force. A minimum team of four trained personnel seems optimum to support operational surges,

⁸⁷ Brett Wetherill (Technical Analyst, Space Training Division, Department of Training and Doctrine, U.S. Army Space and Missile Defense Command), in discussion with the author, May 27, 2015.

24 hour manning requirements during deployment operations, and the need to augment subordinate commands. In addition to the space professional (FA40), the Army includes enlisted and civilian personnel whose primary career field is not space but rather is space-specific. As such, they are best suited to augment the Army space cadre. They are given the additional skill identifier Space Enabler.⁸⁸ The Army space enabler can be compared to the Marine 0540, only difference is that the 0540 is an officer only billet. As of 2012 when the Marine Corps first introduced tactical space operations officer billets, the approximate total strength of the Army space cadre was around 2,595 as opposed to only 13 Marine Corps cadre members.⁸⁹ Given this relatively high number, a healthy scattering of space professionals/enablers can be found throughout Army tactical commands and key joint and DOD organizations.

B. ARMY SPACE SUPPORT TEAM

In certain cases when an SSE is unavailable, becomes understaffed, or when the number of subordinate units requiring space support exceeds the manpower capacity of the organic SSE, the supported unit may be eligible for additional space support augmentation from an ARSST. The ARSST is unique in that it is a total space support package. In other words, it comes fully prepared with personnel and equipment and can simply “plug-in” with an existing SSE to provide further support, product dissemination, critical reach back capabilities, and extra bandwidth capacity.⁹⁰ The mission of the ARSST is similar to the SSE in that it is tasked to plan, coordinate, and analyze the SFE areas while providing daily support and space updates to the supported commander.⁹¹ When integrating into a unit that has an existing organic SSE, the ARSST focuses primarily on producing products and executing tactical space support as directed by the

⁸⁸ Thomas S. Pugsley. 2009, “Army Space Education: Closing the Gap with Operational Space,” Proceedings of the AIAA/USU Conference on Small Satellites, Mission Lessons, SSC09-XII-2. <http://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1339&context=smallsat>.

⁸⁹ Institute of Land Warfare, Association of the United States Army, *U.S. Army Space Capabilities: Enabling the Force of Decisive Action* (Torchbearer National Security Report) (Arlington, VA, 2012), 13, http://www.usa.org/publications/torchbearercampaign/tnsr/documents/tb_smdc_web.pdf.

⁹⁰ Ibid., 11.

⁹¹ Department of the Army, FM 3-14, 6-7.

SSE. This way, the SSE can remain immersed in staff planning activities to include receiving updates to the evolving situation all while the ARSST concentrates on providing specific products and support based on the dynamic requests and direction from the SSE.

1. ARSST Manning

Due to its mission to augment a larger force and the fact that ARSSTs possess organic equipment, there is a validated need for a solid, well-staffed team to manage all required functions. Currently, the ARSST organization is made up of at least six personnel, including both officer and enlisted space professionals/enablers. Figure 8 portrays the ARSST structure broken down by billet title and rank.

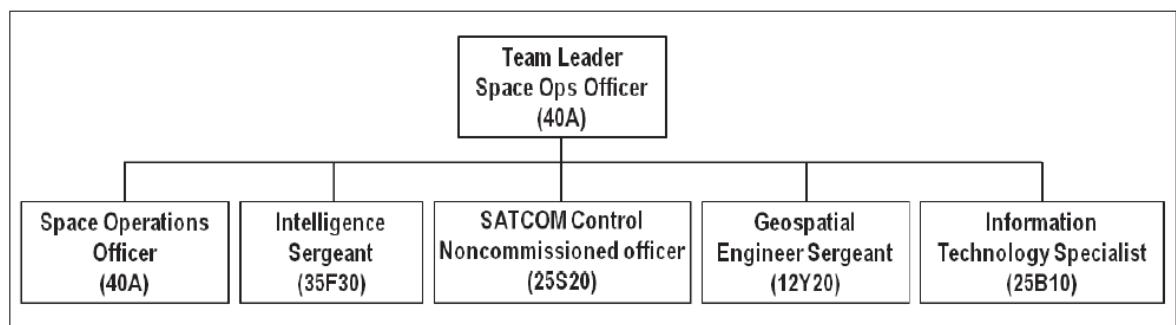


Figure 8. ARSST Personnel Breakdown⁹²

2. ARSST Equipment

As a replacement to the antiquated space operations system workstation, the Army has recently fielded a more robust, capable suite of equipment known as the Distributed Common Ground System Army (DCGS-A). The DCGS-A workstations provide space professionals with unique applications to conduct space analysis, SFE, and space planning. Aside from the DCGS-A equipment suite, other equipment that supports the ARSST mission includes but is not limited to printers, plotters, telephone communications, and various sized storage devices that support increasing amounts of

⁹² Ibid.

large data files.⁹³ The SSE relies on the ARSST and its use of this equipment to provide quick and efficient products to the supported command.

3. ARSST in Support of the MEF

Throughout Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF), and prior to the establishment of the MEF 8866 in 2012, the MEF did not have personnel whose jobs were solely dedicated to exploiting the space domain. Instead, the MEF relied upon a standing relationship with the Army that integrated ARSSTs with the MEF staff while forward deployed. After a formal request for forces was submitted, the ARSST/MEF relationship began in 2005 during OIF and continued through OEF ending in 2014. The request for forces agreement has since expired.⁹⁴ After action reports from at least four different ARSST teams were acquired in order to examine best practices and identify shortfalls/challenges. The following sections provide a short summary of the headlining issues and findings that were similar in each thus establishing a notable trend.

a. Personnel

Each ARSST deployed with the correct manning requirement of six team members. Each team reported that six personnel was sufficient to accomplish the mission, but in some cases concluded that additional support would have been beneficial. For example, an ARSST works best when it can augment an already established SSE. In the case of providing support to the MEF, an organic SSE was not available thus causing the ARSST team leader to take on the additional responsibility of participating in relevant MEF staff planning meetings and functions in order to ensure the alignment of ARSST/MEF actions and priorities.⁹⁵ Similarly, each team commented on the importance of deploying with team members who are more senior in rank to the doctrinal

⁹³ Ibid., 6-8.

⁹⁴ Michael Russell (Contractor, Air Force Warfare Center, Schriever AFB, CO), in discussion with the author, March 18, 2015.

⁹⁵ Donald Messmer, Debriefing report of ARSST 20 supporting I MEF at Camp Leatherneck RC-SW Afghanistan deployed from 4 March 2010 to 24 November 2010 (After Action Report) (Colorado Springs, CO: Space and Missile Defense Command Future Warfare Center, 2010), 6.

ARSST personnel breakdown. The argument here is that ARSSTs generally support higher level organizations that require senior officer and noncommissioned officer interaction, as is true when integrating with a MEF staff.⁹⁶ Furthermore, ARSST 28 team leadership, who was in support of II MEF during OEF, cited that a few team members had to work 15–18 hour workdays to meet minimum requirements. Moreover, it was mentioned that if engaged in a conflict with a “near space peer adversary,” a six person team would be insufficient. As such, their recommendations concluded that a minimum eight person team would be necessary in such a conflict.⁹⁷

b. Organization

In most cases, supporting ARSSTs were aligned in the MEF under the G-3 FECC which is consistent with the current, planned concept of employment. However, the after action reports that were studied noted two distinct reporting chains of command within the FECC. On one hand, the ARSST sometimes fell directly under the IO officer which essentially categorized the space mission as an IO specific effect and a subcomponent of the IO cell. On the other hand, there were a few instances when the ARSST fell directly under the fires and effects coordinator (FEC) which removed at least one link in the reporting chain and gave the ARSST commander direct access to the FEC. ARSST 22, who supported both I and II MEF on a single deployment was able to experience both configurations. The team leadership noted that alignment directly under the FEC and acting as a “peer” to the IO and fires sections was the better, more functional structure which offered maximum flexibility when planning for both space support and STO programs.⁹⁸ This allowed the ARSST commander the ability to coordinate directly with

⁹⁶ Donald Messmer, Debriefing report of ARSST 26 supporting I MEF in Iraq and RC-South deployed from 8 July 2009 to 24 March 2010 (After Action Report) (Colorado Springs, CO: Space and Missile Defense Command Future Warfare Center, 2011), 1.

⁹⁷ Donald Messmer, Debriefing report of ARSST 28 supporting RC (SW) in OEF USCENTCOM from 2 July 2011 to 5 April 2012 (After Action Report) (Colorado Springs, CO: Space and Missile Defense Command Future Warfare Center, 2012), 7.

⁹⁸ Donald Messmer, Debriefing report of ARSST 22 supporting II MEF in OEF USCENTCOM from 1 November 2010 to 10 August 2011 (After Action Report) (Colorado Springs, CO: Space and Missile Defense Command Future Warfare Center, 2011), 1.

the technical IO officer for STO and alternate compensatory control measure (ACCM) tasks while going straight to the FEC for non STO/ACCM space operations.

c. Key Support Provided

The support provided by each ARSST varied slightly depending on the conflict, operation, and which MEF they were in support of. Even so, there were a few similar, fundamental tasks and services provided by each ARSST. Among those most commonly provided were the authoring and dissemination of the daily space reports and annex N, education concerning alternative imagery collection means, participation in and development of comprehensive theater missile warning drills and procedures, poppy detection and mapping utilizing spectral imagery, and STO/ACCM program management.

(1) Space Reports and Annex N

The daily space report could be considered one of the most fundamental, services that an ARSST or SSE can provide. On a daily basis, each ARSST would put together a brief containing specific space products to include but not limited to space weather, GPS EMI, SATCOM links, and spectrum management reports that were tailored to fit a designated operational region. It was noted that these space reports were used extensively by multiple MEF staff sections and MSCs throughout planning and execution.⁹⁹ Also, given that there were no space support personnel organic to the MEF, there were no previously developed Annex Ns included in current operational plans and orders. As a matter of housekeeping, the authoring of an Annex N was among one of the first tasks completed by each supporting ARSST. Through the Annex N, the ARSST was able to clearly convey what contributions space assets could bring to the fight and how they would synchronize with the overall scheme of maneuver.

(2) Education

General SFE education and training of staff and MSCs was a typical duty undertaken by each ARSST. Specifically, team members provided critical education and

⁹⁹ Donald E. Messmer, Debriefing report of ARSST 22, 2.

training concerning GPS accuracy prediction reports which on one occasion led to the development of a GPS users' guide. Likewise, training on the use of alternate intelligence collection measures such as commercial imagery and national technical means was conducted.¹⁰⁰ It was also noted that mobile training teams traveled to specific unit locations to provide critical SFE education and training.¹⁰¹

(3) Theater Missile Warning

ARSST 28 commented that upon arrival to support II MEF in Afghanistan, they discovered that there was no theater ballistic missile (TBM) early warning capability in place. At the time, recent regional developments had deemed TBM early warning a necessary capability and requirement. As a result, ARSST 28 created a fully-functional tier II node which provided early warning to approximately 20,000+ personnel in the area of operations (AOR).¹⁰²

(4) Multi Spectral Imagery/Mapping

It is widely known that income for insurgents in Afghanistan was generated mostly from harvesting and trading of opium derived from the many poppy fields located in the south and southern portions of Afghanistan. The ARSST was in position to provide critical support to poppy growth determinant operations given that nearly 60 % of the poppy cultivation mission occurred in the MEF AOR.¹⁰³ In support of this mission, the ARSSTs reported that they were able to team with the National Air and Space Intelligence Center and utilize spectral imagery to create products that were critical to disrupting the flow of insurgent income. Moreover, these images were combined with other intelligence products that aided in the identification and tracking of insurgents.¹⁰⁴

¹⁰⁰ Donald E. Messmer, Debriefing report of ARSST 26, 3.

¹⁰¹ Donald E. Messmer, Debriefing report of ARSST 20, 2-3.

¹⁰² Donald E. Messmer, Debriefing report of ARSST 28, 3.

¹⁰³ Ibid.

¹⁰⁴ Donald E. Messmer, Debriefing report of ARSST 22, 2.

(5) STO/ACCM

As mentioned in Chapter III, STO and ACCM program management often rests with space trained personnel due to the high level of clearance required. During OIF and OEF, much of the support provided by ARSSTs fell into one of these two categories. The ratio of SFE support to STO/ACCM program management varied with respect to the conflict and was indeed different in both OIF and OEF. For example, ARSST 26 commented that during OIF, approximately 70% of the team's effort was devoted to providing SFE support, 30% to ACCM, and nothing to STO. However, when the team moved to OEF the ratio of duties shifted to 75% to ACCM, 15% to STO, and 10% to SFE support.¹⁰⁵ In his 2009 Master's thesis, *Space support for the warfighter: determining the best way to provide space capabilities at the Army division and brigade levels*, Major Eric Strom referenced a study that was conducted during 2008 by the Space and Missile Defense Command that examined the percentages of SSE personnel time that was spent on space-related duties from 2002–2008 during OIF/OEF. The study revealed that time spent on space activities decreased from 95% to 31%, while time spent on non-space activities increased from 5% to 69%. In his thesis, Maj Strom contends that the trend away from space was due to increased familiarity of the mission over time and that specific space knowledge and expertise was inherently ingrained within the various sections of the division staff. He concluded that the addition of organic space trained personnel at the division level was perhaps overkill.¹⁰⁶ Overall, as SFE planning and execution become more predictable, it is only natural that ARSSTs and SSEs focus on ACCM/STO in order to contribute to the fight in a more dynamic matter. However, today the U.S. certainly does not stand alone as a growing space power as other nations steadily increase their space capabilities. In the future, if the U.S. becomes engaged in a more conventional type of war, the need for space professionals at the lowest tactical level will be an absolute necessity to accommodate the dynamic nature of SFE.

¹⁰⁵ Donald E. Messmer, Debriefing report of ARSST 26, 2.

¹⁰⁶ Eric N. Strom, "Space Support for the Warfighter: Determining the Best Way to Provide Space Capabilities at the Army Division and Brigade Levels," 2009.

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V. RECOMMENDED METHODS FOR INTEGRATING SPACE SUPPORT WITHIN THE MEF

A. OVERVIEW

This study set out to examine the concept of space support to Marine Corps operations. Up to this point, significant focus has been placed on educating the reader concerning how effective use of the space domain and assets therein can augment the execution of Marine Corps warfighting functions and facilitate the expeditionary employment concept. This study also sought to investigate the current progress and implementation methods of space operations at the MEF given the recent introduction of space trained personnel at the staff/planning level. As a comparison, readers were introduced to the basic Army space support models with proven track records of integrating with the MEF. As indicated by this study, it is clear that the MEF has not yet fully integrated the space operations officer and still lacks the fundamental knowledge and means necessary to fully exploit space-based capabilities.

The focus of this chapter is to guide the reader through an organized recommendation analysis following the doctrine, organization, training, material, leadership and education, personnel, and facilities (DOTMLPF) format. As a viable assessment method, the military often approaches existing problems by considering solutions involving any combination of the DOTMLPF spectrum. For purposes of this study, we will focus on providing potential recommendations within the organization, training, material, leadership and education, and personnel categories.

B. ORGANIZATION

The current, doctrinal organization of the FFCC will undergo significant changes in the summer of 2015. During the 2014 operational advisory group, representation from the FFCC advocated that the current MAGTF fires publication does a poor job of representing how the FFCC is currently manned and operated. The consensus among

stakeholders was that the FFCC must be restructured and renamed as the FECC in order to better portray the coordination of both lethal and non-lethal effects.¹⁰⁷

In Chapter III, the structure of each MEF FECC was examined to capture where the MEF 8866 would reside and operate. Interestingly, the employment of the 8866 within each MEF is vastly different with no apparent coordination occurring between the MEFs. Without an actively employed 8866 in I or II MEF, there is no way to compare the organizational effectiveness via lessons learned and best practices. This is a limiting factor in this research and does not provide an accurate way to measure the achievements and true performance of the III MEF 8866 thus far. Nevertheless, based on relevant interviews, after action reports, and experiences of the III MEF 8866 and ARSSTs supporting the MEF, the following organizational recommendations should be considered.

1. Standalone Space Operations Cell

The experiences of the III MEF 8866 and ARSSTs in support of MEF operations have highlighted the benefits of allowing the 8866 the freedom to operate independently within the FECC. In this configuration, the 8866 would be directly responsible to the FEC giving him/her leverage and vital cross support flexibility to coordinate with adjacent sections throughout the FECC and G-3. Space operations support a broad range of capabilities, therefore the 8866 must have the freedom to influence all aspects of the fight. Also, by adding to the modularity of the FECC, a standalone space operations cell would simplify and standardize the process of including additional space support personnel during deployment and operational surges. ARSST integration would be uniform throughout each MEF which would help eliminate any growing pains that occur during initial stages of support. In the event the 8866 is tasked as the primary STO manager, he/she will have direct access to the FEC for all STO/space operations matters. Any STO personnel support could also be included within this cell to facilitate the management of the program. Given that the FECC is still in a transformation stage, the addition of the space operations cell is not as far-fetched as it may seem and would

¹⁰⁷ William Mangus (II MEF Deputy FEC), in discussion with the author, April 1, 2015.

ultimately help to continue the education of the MEF staff concerning space support operations and would serve as a catalyst for change in regard to how the MEF incorporates space-based capabilities in the future.

2. Technical Fires Cell

The current placement of the 8866 within each MEF was identified in Chapter III. The major differences noted were that the MEFs do not agree, or have not yet agreed upon how to categorize space operations capabilities. I MEFs understanding of space has led the leadership to include the 8866 within the lethal fires category. In doing so, they have deemed that space-based capabilities play a huge role in the execution of lethal fires and as such should be synchronized within the lethal fires planning and targeting process. In contrast, II MEF has initially advocated that space operations should be lumped into a non-lethal category with other technical MOSs. Their thought process was to separate kinetic and non-kinetic disciplines and build synergy among the technical MOSs. In III MEF, they have categorized space operations as neither kinetic/non-kinetic nor lethal/non-lethal, which was largely based on the fact that space capabilities are woven throughout each of the warfighting functions and thus can be classified as any combination of the above mentioned categories.

A potential reason for the differences in employment could stem from a greater lack of understanding of space-based capabilities among the MEF staff and what they can bring to the fight. For instance, a non-kinetic event does not necessarily mean that the effect will be non-lethal. The OSC mission was covered in Chapter II, with the idea being that the U.S. will attempt to deny, disrupt, degrade, or destroy adversary space-based capabilities that prove a national security threat. From a continuum of force perspective, disrupting a capability is not the same as destroying it. Therefore, you could conceivably categorize space based capabilities as both lethal and non-lethal depending on the situation and specific capability provided. III MEF seems to have grasped this concept which explains their initial 8866 employment and placement choice.

Going forward, if the standalone space operations cell will not be implemented, a technical fires cell should be assessed. This cell would encompass the 8866 along with

the other potentially lethal and non-lethal MOSSs in order to build synergy among these disciplines. This cell would focus primarily on integrating capabilities early and often within the planning process yet would also be privy to current operations occurring within the FECC in order to make adjustments on-the-fly.

C. TRAINING

In the U.S. Marine Corps Commandants Planning Guidance 2015 document, General Dunford emphasized that “we must win today’s battles while evolving, innovating, and adapting to win tomorrow’s fight.”¹⁰⁸ From a space perspective, the time is now to prepare for potential conflict with a near peer space adversary. In regard to incorporating space training objectives into MEF exercises, III MEF has set the initial standard. As was done in III MEF, the initial goal for I and II MEF upon gaining a dedicated 8866 should be to first identify major joint exercises that will help promote space training objectives. Along with exercise identification, specific relationships with joint space support organizations and personnel should be established. These relationships will ultimately help build the foundation by which the MEF executes space operations, requests external space support, and prepares for space training events in support of MEF level training evolutions. Building on the experiences of III MEF, the space cadre should collaborate to create a common, working database of measurable, exercise inject events that will help assess the status and increase the proficiency of space operations at the MEF. As the space domain becomes more contested due to adversary activity, the MEF must be ready to react to any given situation.

1. Exercise Assessment

Per the Army Space Operations field manual, the assessment of space operations is broken down into two categories known as measures of effectiveness/performance which could provide a warm start capability for inclusion into MEF level exercises.

¹⁰⁸ Commandant United States Marine Corps, *36th Commandant’s Planning Guidance* (Washington, DC: United States Marine Corps, 2015), 2, http://www.hqmc.marines.mil/Portals/142/Docs/2015CPG_Colour.pdf.

Measures of effectiveness relate to the ability to detect changes in the operational environment or a systems behavior. The following are examples of measures of effectiveness as portrayed by the Army Space Operations field manual:

- Has solar activity impacted GPS and precision navigation
- Ability of resolution processes to resolve SATCOM or GPS EMI in a timely manner
- Timeliness of receipt of commercial satellite imagery products¹⁰⁹

Measures of performance relate to being able to assess friendly actions as they apply to task accomplishment. The following are examples of measures of performance as portrayed by the Army Space Operations field manual:

- Success or failure of FFT infrastructure to enable the COP
- Have mitigation measures enabled uninterrupted operations
- Have missile warning alerts provided sufficient accuracy and time to take protective measures.¹¹⁰

2. Joint Space Support Collaboration

Of the varying joint space support models, the MEF should elect to collaborate specifically with the United States Army Space and Missile Defense Command (USASMDC) as well as the 527th Space Aggressor Squadron.

a. USASMDC/ARSTRAT

USASMDC/ARSTRAT has been supporting the MEF for more than a decade during OIF/OEF through the 1st Space Brigade who is the primary space force provider for the Army. One of the primary functions of the 1st Space Brigade is to “provide tailored Army space forces to assist units without organic SSEs such as theater sustainment commands, joint task forces and Marine forces.”¹¹¹ 1st Space Brigade support has come largely by ARSST integration during deployment operations and these past successes have warranted continued integration. Additionally, the MEF should coordinate specifically with SMDC/ARSTRAT’s Directorate for Training and Doctrine

¹⁰⁹ Department of the Army, FM 3-14, 5-5.

¹¹⁰ Ibid.

¹¹¹ Department of the Army, FM 3-14, 6-1.

to see how they inject space operations tasks into Master Events Sequence Lists (MESLs) for training exercises.

b. 527th Space Aggressor Squadron

The mission of the space aggressor squadron is centered on preparing U.S. forces to operate in a space contested environment against adversaries who are actively striving to disrupt, deny, degrade, or destroy space systems and the capabilities that they enable. The space aggressors provide a thorough training package that includes educating the supported command on all current and potential adversary systems and tactics, aiding in the development and assessment of exercises containing space based objectives, and replicating space related threats such as GPS and SATCOM jammers as well as adversary communications systems.¹¹² The MEF should strive to include the space aggressors in creating a fundamental space training plan based on selected exercises and desired training objectives.

D. MATERIAL

Currently, the MEF 8866 does not have a dedicated set of equipment with software that is needed to access space planning and support applications. In order to contribute to the fight in a more effective manner, the following software and equipment recommendations should be considered to help further build the concept of space support within the MEF.

1. Software

The most effective piece of equipment required by the space operator to support the mission is a laptop computer outfitted with software that provides the capability to process certain space-related applications in order to determine mission planning information. The MEF 8866 will rely on this software and will need access to it across all classification levels. At minimum, the MEF 8866 should have access to the following software for processing space-related information:

¹¹² David Futty (Navy Liaison, 527th Space Aggressor Squadron), in discussion with the author, April 23, 2015.

- GPS Interference and Navigation Tool (GIANT) for providing GPS accuracy prediction reports
- Systems Toolkit (STK) Analysis software for visual and statistical prediction of satellite overflight data
- Google Earth Pro/Enterprise Client for being able to reference the military grid reference system as well as importing satellite imagery for COP needs, planning considerations, or intelligence sharing
- Some sort of geographic information software such as environment for visualizing images (ENVI) for downloading and doing basic processing of satellite imagery

This is certainly not an all-inclusive list, but will provide the 8866 with the basic tools to help convert strategic level information into a more tactical warfighting application. Of note, it is possible that the MEF G2/G6 may already have access to a number of these programs. Even so, the MEF 8866 should possess dedicated computers used solely for space support planning. Additionally, the licenses needed for some of this software can be quite costly. However, if compared to the cost to own, manage, and maintain organic equipment such as the Army's DCGS, it seems like a very cost effective, near term option when facing perpetual defense budget cuts.

2. Equipment

As the 8866 begins to take a more active role in MEF level planning, exercises, and operations, the gradual progression should be to eventually obtain organic MEF space support equipment. In the near term, a robust system such as the Army's DCGS may not be necessary or feasible. Instead, there are a number of up and coming equipment solutions that may help integrate space training objectives into MEF level exercises and more importantly simulate operating in a space denied and degraded environment. In particular, the USASMDC space training and exercise division has been working in conjunction with the future warfare battle lab to develop a series of space training kits that are helping to improve the overall conduct of space training across the force. While these training kits are currently still in the development and testing phase, they have been fielded within USASMDC and have since proven worthy pieces of

equipment. The following sections offer a brief summary of the capabilities of each kit as applicable to normal, enhanced, and contested operations.¹¹³

a. Kit # 1: iSpace Tablet

Pictured in Figure 9, Kit # 1 consists of commercial off the shelf (COTS) android tablets with protective cases and unclassified applications installed that would normally be available to the space operator through a dedicated suite of software and computer systems. The benefit of having a portable tablet is that warfighters can have access to this critical information while on the move without the need to remain connected to an existing network. Furthermore, a tablet with applications provides a more intuitive training aid for the 21st century warfighter and is sharable with coalition partners due to their unclassified nature. The following list details some of the capabilities provided by kit # 1:

- Precision Dilution of Precision application used to predict GPS accuracy for any given location on the Earth
- Overfly application used to determine ground site visibility and overpass times for selected satellites
- Look angle application used to determine angles from ground site to satellite
- Satellite augmented reality application used to display an accurate depiction of satellites in their current location across the sky
- Space weather applications used to access information concerning space weather events that could potentially impact communications¹¹⁴

¹¹³ Brett Wetherill (Technical Analyst, Space Training Division, Department of Training and Doctrine, U.S. Army Space and Missile Defense Command), in discussion with the author, May 27, 2015.

¹¹⁴ Brett Wetherill (Technical Analyst, Space Training Division, Department of Training and Doctrine, U.S. Army Space and Missile Defense Command), in discussion with the author, May 27, 2015.



Figure 9. iSpace Tablet¹¹⁵

b. Kit # 2: TOC-in-a-Box

Pictured in Figure 10, Kit # 2 consists of COTS equipment designed to increase awareness of enhanced capabilities available to warfighters as well as force protection. The target user for kit # 2 is a small unit operating in remote locations. Some of the capabilities of kit # 2 include:

- GPS tracking mechanisms to facilitate FFT, instant messaging, and data transfer among users
- Ground based weather sensors
- Unattended ground sensors capable of detecting and distinguishing between different types of motion that can aid in force protection¹¹⁶

c. Kit # 3: Space Degradation Simulation Trainer

Kit # 3 is specifically designed to help train forces in a simulated, space contested environment and consists of equipment that can replicate the effects of GPS and SATCOM jamming/spoofing. Kit # 3 would be especially beneficial to the MEF as it can help prepare an expeditionary force for potential crisis or conflict where space superiority may not be sustainable.¹¹⁷

¹¹⁵ Ibid.

¹¹⁶ Ibid.

¹¹⁷ Brett Wetherill (Technical Analyst, Space Training Division, Department of Training and Doctrine, U.S. Army Space and Missile Defense Command), in discussion with the author, May 27, 2015.



Figure 10. Space Degradation Simulation Trainer¹¹⁸

E. LEADERSHIP AND EDUCATION

Educating key leaders within the MEF as well as MSC staff members is a basic principle yet is also one of the most important tasks that an 8866 will accomplish. This research has identified that one of the causes of an underutilization of the 8866 is due to a simple lack of understanding of what capabilities are afforded by the space domain and how they contribute to the fight. The III MEF 8866 placed a special focus on educating MEF leadership through use of various periods of instruction to help build the picture of how space affects a particular audience and mission set. His efforts training the staff created a following of space interested Marines which assisted in further development and integration of the billet within the MEF. Additionally, it was recognized that the education obtained by the 8866 through a graduate degree in space systems operations is noteworthy, yet there are a host of other training venues that can either build upon current knowledge and/or introduce new concepts.¹¹⁹

1. Train the Staff

There are a number of space community training courses available that can be delivered to the MEF staff and MSCs. Courses should be investigated and arranged by the MEF 8866 through the Joint Staff, ARSMDC, Navy Cyber Forces Command, and the National Security Space Institute. Every effort should be made to accomplish this training

¹¹⁸ Navigation Systems Corporation, Space Kit 3: Space Degradation Simulation Trainer Spec Sheet (Colorado Springs, CO: The Navigation System Innovators).

¹¹⁹ Brian Anderson (III MEF Space Operations Officer), in discussion with the author, October 28, 2014.

through mobile training teams if available. The following is a list of potential courses that may benefit the space community and MEF staff as a whole:

- STO planners course
- Planning and Decision Aid System Users Course
- FA40 Space Operations Officer Qualification Course
- Tactical Space Operations Course
- Naval Space Operations Course
- Space 200/300
- Space Professional Development Program¹²⁰

2. 8866/0540 Schoolhouse and Sustainment

Due to the technical nature of these MOSs and continued growth and complexity of space-based capabilities, it is important to prevent the atrophy of critical knowledge. While the 8866 receives an in-depth, two year graduate degree in space systems operations, there are certainly additional training venues available to further expand upon this foundation. In particular, it was noted by both I and III MEF 8866s that attendance at the FA40 Space Operations Officer Qualification Course is essential.¹²¹ The Army Space Cadre Development Guide delineates that the purpose of this course is “to develop FA40 Space Operations Officers and other officers and non-commissioned officers designated to fulfill space operations tasks and duties developing, training and integrating space capabilities to support tactical, operational, strategic military operations.”¹²² Likewise, the 0540 should seek to build on the foundation started through attendance at the space 200 course which prepares students for intermediate-level leadership roles within the space community.

¹²⁰ Brian Anderson, The First 100 Days as the III MEF Space Operations Officer, 6.

¹²¹ Christine Rabaja (I MEF Staff Secretary), in discussion with the author, June 2, 2015.

¹²² Army Space Personnel Development Office, Army Space Cadre Development Guide, July 16, 2010, 7.

F. PERSONNEL

One of the biggest frustrations experienced by the III MEF 8866 was the critical lack of 0540 trained personnel in the MEF and MSCs to help work on space planning, training, and issues.¹²³ These observations paired with the identified personnel shortfalls explained by the ARSST/MEF integration after action reports demonstrate that the MEF is not currently prepared to fully exploit space-based capabilities or operate in a space denied and degraded environment. Further compounding the issue is the need to conduct 24 hour space support during deployment or crisis response operations. Going forward, the Marine Corps should address this issue and consider increasing the number of qualified 0540s on the MEF staff, look to establish a standing request for forces agreement between USMDC/ARSTRAT and each MEF, and seek to adopt a modest proposal by MARFORSTRAT to initiate a space officer Individual Marine Augment (IMA) reserve detachment.

1. Increase the Number of Trained 0540s

Of the 49 official 0540 billets established throughout the Marine Corps, supporting establishments, and joint agencies, there are currently only five dispersed among the MEFs. Furthermore, there are many cases in which these assigned officers neither know they are filling a 0540 billet nor have been to the required training. Nevertheless, these officers are expected to fulfill their duties as a space operations staff officer in conjunction with their primary MOS duties within their respective functional areas. More often than not, the majority of an 0540s time is spent supporting their primary MOS, leaving a single dedicated MEF 8866 to plan for space-based capabilities which is insufficient during operational surges requiring 24 hour manning.

As an FMOS, it should be fairly easy to advocate increasing the number 0540s within each MEF. Target personnel should be those officers holding an intelligence or communications primary MOS. In FY16, the Marine Corps Training and Education Command will begin funding the space 200 course needed to certify the 0540 which

¹²³ Brian Anderson (III MEF Space Operations Officer), in discussion with the author, October 28, 2014.

should help lessen the burden on the MEF to fund this training.¹²⁴ A good target number of 0540s within the MEF is six. This number matches that of a fully manned ARSST and will provide a cushion in the event a few or more of the 0540s are tasked elsewhere.

2. Indefinite Request for Forces

As discussed in Chapter IV, Army space professionals have been augmenting the MEF for over a decade. Their successes have instilled the importance of continuing to broaden the Marine Corps' reach within the joint space community and build a stronger base of organic space trained personnel. Implementing new Marine Corps force structure to achieve this goal will remain challenging as we continue to do more with less.

Instead of adding new force structure in the near term, the Marine Corps should seek to create a standing request for forces between each MEF and USMDC/ARSTRAT to continue the invaluable support that was provided during OIF/OEF. Under this proposed model, the MEF would advocate for an Army SSE or ARSST to support all major exercises, pre-deployment training, and combat deployments. Formalizing the concept of ARSST/SSE support to the MEF is a viable solution given the fact that any requests to add new Marine Corps force structure will be heavily scrutinized. One of the added benefits of this standing augmentation request is that it will help build synergy between each service through regular training and integration which will effectively eliminate any cultural and operational barriers during deployment operations. Ultimately, ARSST/SSE support under the supervision and direction of the 8866 will continue to help build the base concept of space support within the MEF and pave the way for future developments.

3. Space Officer IMA Detachment

As a response to the critical lack of trained space professionals within the Marine Corps and joint space support agencies, MARFORSTRAT has begun planning to implement a space IMA reserve detachment. The primary purpose of the IMA will be to

¹²⁴ Brian Anderson (III MEF Space Operations Officer), in discussion with the author, October 28, 2014.

augment JFCC-Space, the JSpOC, and Marine Corps warfighting units during major exercises, operational surges, and when new space capabilities and requirements emerge that require additional manpower. IMAs would be individually selected and screened to attend the space 200 course to earn the FMOS 0540 and would subsequently be available to support additional manpower requirements. MARFORSTRAT recommended a total of 10 IMA personnel consisting of a mix of officer ranks (O-3/O-4).¹²⁵

Once this proposal is approved and implemented, the MEF should look to draw from this IMA detachment early and often to facilitate training of the Marine Corps as a whole and support any manpower deficiencies that have been preventing the MEF from fully embracing the Marine Corps space operations concept.

¹²⁵ Miguel Alvarez (Marine Forces Strategic Command, Space Operations Officer), in discussion with the author, June 4, 2015.

VI. CONCLUSION AND RECOMMENDED FUTURE WORK

A. CONCLUSION

Since the inception of the Marine Corps tactical space operations officer in 2012, there has been little to no progression with regard to developing the billet and integrating space operations throughout the MEF. Relying on non-organic space support means throughout over a decade of war in OIF/OEF was dependable only because of the given scenario and predictable adversary. Moving forward as the nation's expeditionary force in readiness, the Marine Corps can no longer wait to prepare for a potential conflict with a capable adversary who truly understands the level upon which we rely on space-based capabilities.

This study has sought to educate the reader on how space relates to the Marine Corps warfighting functions and demonstrates that the level of reliance on space will only increase with time. Through an analysis of each MEF, gaps have been identified, demonstrating to the MEF staff that a critical asset has been underutilized causing a failure to exploit the full capabilities that an in-depth knowledge of space-based assets can provide. The focus was shifted to Army joint space support models to help demonstrate how beneficial it is to have access to space smart individuals who can take advantage of the available tools necessary to harness space-based capabilities. Those interactions have more than highlighted the need to continue strengthening a space cadre of Marines at the tactical level. Finally, the recommended courses of action are based on the concept of experimentation. If the Marine Corps desires to be prepared to fight tomorrow's battle, it must adapt, innovate, and overcome the challenge of sticking to the status quo. The future modifications and integration of space operations at the MEF level will undoubtedly serve as the cornerstone to implementation at lower levels and will continue to revolutionize the way we fight.

B. FUTURE WORK

1. 8866 as a Primary MOS

With an advanced degree in space systems operations, the 8866 is armed with a wealth of knowledge which is put to use in an immediate payback tour. However, following this tour, the 8866 reverts to their primary MOS and may or may not return to the space operations field. In order to protect the investment in these highly trained personnel and ensure that they remain abreast of the continuing evolution of capabilities and practices, it is imperative that the Marine Corps assess and establish a plan to retain this knowledge by creating an 8866 PMOS.

2. Integration of Space Support in the MEU

The Marine Corps is amphibious by nature and is deeply tied to naval activities. As such, a similar study as this should be applied at lower levels within the Marine Corps and should focus first on integrating space systems operations at the MEU.

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